FINAL

RECORD OF DECISION AMENDMENT
OPERABLE UNIT 1 (OU-1)
SITE LF004
FORMER WILLIAMS AIR FORCE BASE
MESA, ARIZONA

Prepared for:
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
1,1-DCE	1,1-dichloroethene
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AF	U.S. Air Force
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AMEC	AMEC Environment & Infrastructure, Inc.
ARARs	applicable or relevant and appropriate requirements
ARS	Arizona Revised Statute
AST	aboveground storage tank
ASU	Arizona State University
AWQS	aquifer water quality standards
BEM	BEM Systems, Inc.
bgs	below ground surface
BIA	Bureau of Indian Affairs
Cal EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CHHSL	Cal EPA Human Health Screening Level
cis-1,2-DCE	cis-1,2-dichloroethene
COC(s)	chemical(s) of concern
COPC(s)	chemical(s) of potential concern
CRWQB	California Regional Water Quality Board
DEUR	Declaration of Environmental Use Restriction
EPA	U.S. Environmental Protection Agency
EPC(s)	exposure point concentration(s)
ESD	Explanation of Significant Difference
ESL	environmental screening level
FFA	Federal Facility Agreement
FFS	Focused Feasibility Study
ft	feet, foot
ft/d	feet per day
gpm	gallons per minute
GRIC	Gila River Indian Community
HI	hazard index
IC(s)	institutional control(s)
IDW	investigation-derived waste
ILCR	incremental lifetime cancer risk

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

IT	IT Corporation
IWAS	in-well air stripping
LF004	Landfill 004
MCL(s)	maximum contaminant level(s)
mg/m^3	milligrams per cubic meter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priority List
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OU	Operable Unit
PCE	tetrachloroethene
RAOs	Remedial Action Objectives
RI	Remedial Investigation
ROD	Record of Decision
RSL(s)	Regional Screening Level(s)
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TBC	to be considered
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
URS	URS Corporation
VOC(s)	volatile organic compound(s)

1.0 DECLARATION

1.1 Site Name and Location

The former Williams Air Force Base (AFB) National Priority List (NPL) Site, Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID AZ7570028582, is located in Maricopa County, Mesa, Arizona (Figure 1-1). Landfill 4 (LF004) (Figure 1-2) is part of Operable Unit (OU)-1 of the former Williams AFB.

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) Amendment presents a fundamental change to the LF004 remedy selected in the OU-1 ROD dated April 1994 (AFBCA, 1994) by adding remedial actions for soil gas and groundwater. The amended Selected Remedy for LF004 at the former Williams AFB in Mesa, AZ, was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Public participation requirements of CERCLA §117(c) and NCP 300.435(c)(2)(ii) were implemented in support of the ROD Amendment and amended remedy selection.

The U.S. Air Force (AF) and the U.S. Environmental Protection Agency (EPA) jointly select the amended remedy for LF004 and the State of Arizona concurs with the amended Selected Remedy. Information supporting this decision is contained in the Administrative Record file for LF004, and this ROD Amendment will become part of the Administrative Record file. The Administrative Record is available at all hours online at http://afrpaar.lackland.af.mil/ar/. Documents comprising the Administrative Record can also be accessed at the former McClellan AFB, located at 3411 Olson Street, McClellan, CA 95652. An information repository is available at the Government Documents Section of Arizona State University (ASU) Library, 300 East Orange Mall, Tempe, Arizona.

1.3 Assessment of the Site

The amended response action selected in this ROD Amendment is necessary to protect public health or welfare, or the environment, from actual or threatened releases into the environment of hazardous substances and pollutants or contaminants from LF004 which may present an imminent and substantial endangerment to public health or welfare.

The OU-1 ROD, signed in April 1994 (AFBCA, 1994), selected a LF004 remedy that included a permeable cap to provide landfill closure, limit exposure to dieldrin and beryllium in surface soil, and control natural erosion processes; an interceptor trench around the perimeter of the capped area for collection and routing of stormwater runoff; a perimeter fence and warning signs to limit access and provide notification for the landfill cap; post-closure care for 30 years to include cover maintenance and inspections, groundwater monitoring, maintenance of monitoring equipment; and land use restrictions to protect the integrity of the landfill cover and the groundwater monitoring system. The sewage sludge trenches (Site DP028) were added to the OU-1 ROD for LF004 by an Explanation of Significant Difference (ESD) (AFBCA, 1995). The

sewage sludge trenches were included under the LF004 capped area and are subject to the same OU-1 ROD requirements for monitoring, maintenance, and restrictions established for LF004. The OU-1 ROD did not select a soil gas and groundwater remedy for LF004 because, at the time, there were no identified soil gas or groundwater impacts that required remedial action.

Post-closure groundwater monitoring at LF004 identified tetrachloroethene (PCE) and trichloroethene (TCE) at levels exceeding EPA maximum contaminant levels (MCLs). Subsequently, the AF conducted a supplemental remedial investigation (RI) to investigate contaminant sources and characterize the nature and extent of TCE and PCE in groundwater. Based on the findings of the Supplemental RI (URS, 2010c), a Focused Feasibility Study (AMEC, 2013a) was completed to evaluate remedial alternatives for soil gas and groundwater impacts at LF004. Subsequently, the Amended Proposed Plan for OU-1, LF004 (AMEC, 2013b) identified FFS Alternative 5, In-Well Air Stripping, Oxidation and Soil Vapor Extraction as the preferred soil gas and groundwater alternative. This OU-1 ROD Amendment documents a change in the LF004 remedy in order to address TCE and PCE in soil gas and groundwater.

1.4 Description of the Amended Selected Remedy

The amended LF004 Selected Remedy to address PCE and TCE in groundwater and soil gas is Focused Feasibility Study (FFS) Alternative 5: In-Well Air Stripping (IWAS), Oxidation, and Soil Vapor Extraction (SVE). Remediation wells utilizing air sparging are a technology element of FFS Alternative 2 that is retained for potential implementation to augment the amended Selected Remedy. IWAS and oxidation will treat contaminated groundwater and SVE will treat soil gas. Air stripping and air sparging are processes of aerating groundwater to transfer contaminants from the dissolved phase into the air. Volatilized contaminants can then be collected by SVE and treated at the surface. IWAS is the process of aerating groundwater inside of an extraction well, eliminating the need for above ground infrastructure to treat groundwater. The IWAS wells create a recirculation pattern in the aquifer resulting in remediation of groundwater around a well. IWAS wells use a combination of mechanisms to simultaneously treat groundwater and unsaturated soil contamination. To shorten the time frame for operating the IWAS wells, oxidants such as ozone, hydrogen peroxide, or permanganate would be added either to the IWAS well or using a separate injection well to degrade the contaminants in place. Air sparging wells introduce air into the saturated zone that moves upward and outward toward the vadose zone, creating an in-situ underground air stripper that removes contaminants by enabling phase transfer of VOCs from the dissolved or adsorbed state to the vapor phase. The SVE system would extract and treat contaminants stripped from the groundwater by the IWAS wells, as well as residual contamination in the unsaturated zone soils and soil gas. Until cleanup levels are achieved, institutional controls (ICs) will be implemented to prevent human exposure to contaminants in soil gas and groundwater. Controls will include restrictions that limit property uses, prohibit groundwater extraction or installation of groundwater wells for other than monitoring or remediation, protect remedial systems, and require that vapor intrusion risk be assessed and/or new structures be designed and built to mitigate unacceptable vapor intrusion risk.

The amended Selected Remedy does not alter the existing remedy components from the OU-1 ROD. The landfill cap, interceptor trench, fencing and signs, land-use restrictions, and post-closure maintenance and monitoring will continue in accordance with the existing OU-1 remedy.

1.5 Statutory Determinations

The amended Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This amended remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). Because this amended remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will continue to be conducted at five-year intervals.

1.6 Data Certification Checklist

The following information is included in the remaining sections of this ROD Amendment. Additional information can be found in the Administrative Record.

- Chemicals of concern (COCs) and their respective concentrations.
- Baseline risk represented by the COCs.
- Cleanup levels established for COCs and the basis for cleanup levels.
- How source materials constituting principal threats are addressed.
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater assumed in the baseline risk assessment and ROD Amendment.
- Potential land and groundwater use that will be available at LF004 as a result of the selected remedy.
- Estimated capital, annual operation, maintenance, and monitoring (OM&M), and total present worth costs, and number of years over which the remedy cost estimates are projected.
- Key factor(s) that led to selecting the remedy (i.e., description of how the Selected Remedy provides the best balance among tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).

1.7 Authorizing Signatures

The AF and EPA approve and select the remedy as stated in this ROD Amendment, and the Arizona Department of Environmental Quality (ADEQ), representative of the State of the Arizona, concurs.

Connie M. Lotfi

FEB 25 2014

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Date

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Date

2.0 INTRODUCTION TO SITE AND STATEMENT OF PURPOSE

The former Williams AFB is located in Maricopa County and lies within the boundaries of the City of Mesa, adjacent to the towns of Gilbert and Queen Creek and portions of unincorporated Maricopa County. The former Williams AFB was an AF flight-training base first activated in 1941. In 1989, Williams AFB was placed on the EPA NPL (Williams AFB, CERCLIS ID AZ7570028582). The Base officially closed in 1993.

Since 1989, the AF has been cleaning up hazardous substance releases at the former Williams AFB as the lead agency under CERCLA with regulatory oversight from the EPA, ADEQ, and Arizona Department of Water Resources (ADWR). Regulatory authority for the former Williams AFB is defined in the Williams AFB Federal Facility Agreement (FFA) (AF, 1990). The primary purpose of the FFA is to ensure that the environmental impacts associated with past activities at the former Williams AFB are thoroughly investigated and appropriate remedial actions are taken as necessary to protect the public health, welfare and the environment. The State agencies speak with one voice in regard to FFA implementation, and ADEQ presents positions on behalf of the State.

The OU-1 ROD, signed in April 1994, did not select a soil gas or groundwater remedy for LF004 because, at the time, there were no identified soil gas or groundwater impacts that required remedial action. Post-closure groundwater monitoring conducted in accordance with the OU-1 selected remedy for LF004 subsequently identified PCE and TCE at levels exceeding EPA MCLs. Accordingly, the AF conducted a Supplemental RI (URS, 2010c) and, based on the findings, an FFS (AMEC, 2013a) was completed to evaluate remedial alternatives for PCE and TCE in soil gas and groundwater at LF004. This OU-1 ROD Amendment documents a change in the LF004 remedy in order to address TCE and PCE in soil gas and groundwater. Public participation requirements of CERCLA §117(c) and NCP 300.435(c)(2)(ii) were implemented in support of the ROD Amendment and amended remedy selection.

Information supporting the OU-1 ROD Amendment is contained in the Administrative Record file for LF004 and the ROD Amendment will become part of the Administrative Record file. The Administrative Record is available at all hours online at http://afrpaar.lackland.af.mil/ar/. Documents comprising the Administrative Record can also be accessed at the former McClellan AFB, located at 3411 Olson Street, McClellan, CA 95652.

3.0 SITE HISTORY, CONTAMINATION AND SELECTED REMEDY

LF004 is located at the southwest corner of the former Williams AFB boundary and is bounded by Old Pecos Road to the north, South Power Road to the west, and East Pecos Road to the south (Figure 3-1). LF004 is part of a 140-acre parcel of the former Williams AFB that is identified as Parcel N. After Base closure, the Bureau of Indian Affairs (BIA) submitted a request for the property on behalf of the Gila River Indian Community (GRIC). Upon satisfying the property transfer requirements of CERCLA, the AF plans to transfer the LF004 property to GRIC as a Public Benefit Conveyance sponsored by the BIA.

A landfill operated at LF004 from 1941 to 1976 and received domestic trash, wood, metal, brush, and construction debris. Like many landfills, small quantities of solvents and chemicals may have been dumped along with the trash. Also, prior to 1973, dried sludge from the sewage treatment plant was taken to LF004 (AFBCA, 1993).

3.1 Site History

The AF has conducted RIs, remedial actions, and groundwater monitoring at LF004 since the beginning of field investigations in 1984. RIs defined the nature and extent of contamination. Remedial actions were conducted to provide landfill closure and address contamination in surface soil. Groundwater monitoring was conducted throughout the RIs and continues as part of post-closure care at LF004. Table 3-1 summarizes the investigations, actions, and monitoring events that have occurred on site to date. In addition to the documents listed in Table 3-1, annual cap inspection, maintenance activities and reporting are ongoing in accordance with the OU-1 ROD.

Table 3-1 Summary of Previous Investigations/Remediation Conducted at LF004

Activities	Dates	Reference	Regulatory Concurrence[1]
Phase I Records Search conducted for the entire former Williams AFB.	1983	Engineering-Science, Inc., *Phase I: Records Search, Williams Air Force Base, Arizona*, February 1984.	Secondary document that supports the final RI Report.
Advanced seven soil borings to 83.5 ft below ground surface. Fifty-two soil samples were analyzed for phenol, oil and grease, lead, chromium, cadmium, and total organic halogens. Lead and chromium were the only detected analytes at concentrations within the background range for each element.	October 1984	AeroVironment, Inc., *Installation Restoration Program, Phase II - Confirmation/ Quantification: Stage 1 Report, Williams Air Force Base, Chandler [sic], Arizona*, January 1986.	Secondary document that supports the final RI Report.
Installed wells LA01 through LA06 in the Middle Unit.	1986	AeroVironment, Inc., *Installation Restoration Program, Phase II - Confirmation/ Quantification: Stage 2 Report, Williams Air Force Base, Chandler [sic], Arizona*, December 1987.	Secondary document that supports the Final RI Report.

Table 3-1 Summary of Previous Investigations/Remediation Conducted at LF004

Activities	Dates	Reference	Regulatory Concurrence[1]
Installed wells LF01-W07 through LF01-W12.	1989 to 1991	IT Corporation (IT), *Final Remedial Investigation Report, Operable Unit 1, Williams Air Force Base, Arizona*, October 1992.	Final report was a supporting document for the OU-1 ROD, signed by EPA and ADEQ.
Conducted Remedial Investigation for OU-1. Collected 10 surface soil samples analyzed for SVOCs, pesticides, herbicides, and priority pollutant metals. Several pesticides were detected in the samples. Other SVOCs, such as phthalates and polynuclear aromatic hydrocarbons, were detected but at low levels.	October 1992	IT, *Final Remedial Investigation Report, Operable Unit 1, Williams Air Force Base, Arizona*, October 1992.	Final report was a supporting document for the OU-1 ROD, signed by EPA and ADEQ.
Conducted Feasibility Study for OU-1. Performed remedial technology screening for the site.	January 1994	IT, *Final Feasibility Study, Operable Unit 1, Williams Air Force Base, Arizona,* February 1994.	Document review comment matrices (IT, 1993b and IT, 1993c).
Published the ROD for OU-1.	April 1994	AFBCA, *Final Record of Decision, Operable Unit 1*, April 1994.	Signed by EPA and ADEQ
Installed permeable soil cap, interceptor trench, fencing and signs.	April 1995 through October 1995	IT, *Final Report, Installation of Permeable Cap LF-04, Williams Air Force Base, Arizona*, October 1995.	No EPA or ADEQ comments found in Administrative Record.
Groundwater sampling events.	February 1995 through March 1997	IT, February 1995 through March 1997, Final Groundwater Sampling Reports.	Secondary document that supports Follow-On RI.
Installed wells LF01-W13 through LF01-W17.	April through May 1997	IT, *Final Report, Operation and Maintenance (O&M) Program Permeable Cap at LF-04, Williams Air Force Base, Arizona*, July 1997.	Secondary document that supports Follow-On RI.
Groundwater sampling and analysis.	September 1997	IT, *Draft September 1997 Groundwater Sampling Report, Williams Air Force Base, Arizona*, March 1998. Final report not located; however, the April/May 1998 report references a final report published in June 1998.	Secondary document that supports Follow-On RI.
Groundwater sampling and analysis.	April/May 1998 through September/ October 1999	Hydrogeologic, Inc., Final Groundwater Sampling Reports, April/May 1998 through September/October 1999.	Secondary document that supports Follow-On RI.
Research for follow-on RI at LF004including installation of four new wells, LF01-W18 through LF01-W21.	Late 1990s to early 2000s	Hydrogeologic, Inc., *Final Follow-On Remedial Investigation Report at LF-04, Former Williams Air Force Base, Arizona*, January 2003.	–Resolution of EPA and ADEQ comments addressed as acknowledged in cover letter to Final Follow-On RI Report.

Table 3-1 Summary of Previous Investigations/Remediation Conducted at LF004

Activities	Dates	Reference	Regulatory Concurrence[1]
Groundwater sampling and analysis.	April 2000 through September 2002	IT, Groundwater Sampling Reports, April 2000 through September 2002.	Secondary document that supports Supplemental RI.
Groundwater sampling and analysis.	April 2003 through August 2004	BEM Systems, Inc., LF004 Semi-Annual Groundwater Monitoring Data Reports, April 2003 through August 2004.	Secondary document that supports Supplemental RI.
Groundwater sampling and analysis.	July 2006	URS Corporation, *Final LF004 GroundwaterMonitoring Report, July 2006*, *Former Williams Air Force Base, Mesa, Arizona*, May 2007a.	Secondary document that supports Supplemental RI.
PDB sampling of LF01-W10, LF01-W16, LF01-W19, and LF01-W21.	August 2006	URS Corporation, *Final LF004 Supplemental Remedial Investigation Work Plan, Former Williams Air Force Base, Mesa, Arizona*, May 2007b.	Secondary document that supports Supplemental RI.
Supplemental RI fieldwork (includes soil, soil gas, groundwater grab sampling, and June 2007 and September 2007 groundwater sampling events using PDB samplers).	2007 through February 2009	URS Corporation, Technical Memoranda (URS, July 2007; URS, November 2007; AFCEE, August 2008; URS, December 2008).	Secondary document that supports Supplemental RI.
Groundwater sampling and analysis.	July 2008	URS Corporation, *Final LF004 Groundwater Monitoring Report, July 2008, Former Williams Air Force Base, Mesa, Arizona*, January 2009.	Secondary document that supports Supplemental RI.
Groundwater sampling and analysis.	January 2009	URS Corporation, *Final LF004 Groundwater Monitoring Report, January 2009 Event, Former Williams Air Force Base, Mesa, Arizona*, May 2009.	Secondary document that supports Supplemental RI.
Groundwater sampling and analysis.	May 2009	URS Corporation, *Final LF004 Groundwater Monitoring Report, May 2009 Event, Former Williams Air Force Base, Mesa, Arizona*, November 2009.	Secondary document that supports Supplemental RI.
Groundwater sampling and analysis.	November 2009	URS Corporation, *Final LF004 Groundwater Monitoring Report, November 2009 Event, Former Williams Air Force Base, Mesa, Arizona*, May 2010.	Secondary document that supports FFS.

Table 3-1 Summary of Previous Investigations/Remediation Conducted at LF004

Activities	Dates	Reference	Regulatory Concurrence[1]
Groundwater sampling and analysis, aquifer testing	December 2009	URS Corporation, *ST035, LF004, and FT002 Monitoring Well Installation and Abandonment and LF004 Cap Installation and Aquifer Testing Report, Former Williams Air Force Base, Mesa, Arizona,* January 2011	Secondary document that supports FFS.
Groundwater sampling and analysis.	May 2010	URS Corporation, *Final LF004 Groundwater Monitoring Report, May 2010 Event, Former Williams Air Force Base, Mesa, Arizona*, January 2011.	Secondary document that supports FFS.
Groundwater sampling and analysis.	November 2010	URS Corporation, *Final LF004 Groundwater Monitoring Report, November 2010 Event, Former Williams Air Force Base, Mesa, Arizona*, March 2011.	Secondary document that supports FFS.
Investigated contaminant sources for soil gas and groundwater and characterized extent of PCE and TCE contamination in groundwater. Completed the LF004 Supplemental RI	December 2010	URS Corporation, *Final Site LF004 Supplemental Remedial Investigation, Former Williams Air Force Base, Mesa, Arizona,* December 2010 (URS, 2010c).	Resolution of EPA and ADEQ comments addressed as part of draft final document (URS, 2010b).
Groundwater sampling and analysis.	May 2011	URS Corporation, *Final LF004 Groundwater Monitoring Report, May 2011 Event, Former Williams Air Force Base, Mesa, Arizona*, November, 2011.	Secondary document that supports FFS.
Groundwater sampling and analysis.	November 2011	URS Corporation, *Final LF004 Groundwater Monitoring Report, November 2011 Event, Former Williams Air Force Base, Mesa, Arizona*, June 2012.	Secondary document that supports FFS.
Completed the LF004 Focused Feasibility Study.	November 2011 – January 2013	AMEC Environment & Infrastructure, Inc., *Final Focused Feasibility Study, Site LF004, Former Williams Air Force Base, March 2013*	Resolution of EPA and ADEQ comments addressed in Appendix F of final document.
Installation, sampling, and analysis of off-site monitoring wells.	January – February 2012	URS Corporation, *Final LF004 Off-Site Well Installation and Sampling Report, Former Williams Air Force Base, Mesa, Arizona*, August 2012.	Secondary document that supports ROD Amendment.

Table 3-1 Summary of Previous Investigations/Remediation Conducted at LF004

Activities	Dates	Reference	Regulatory Concurrence[1]
Groundwater sampling and analysis.	May 2012	AMEC Environment & Infrastructure, Inc., *Final LF004 Groundwater Monitoring Report, May 2012 Event, Former Williams Air Force Base, Mesa, Arizona*, January, 2013.	Secondary document that supports ROD Amendment.
Groundwater sampling and analysis.	November 2012	AMEC Environment & Infrastructure, Inc., *Final LF004 Groundwater Monitoring Report, Annual 2012 Event, Former Williams Air Force Base, Mesa, Arizona*, Pending.	Secondary document that supports ROD Amendment.

Notes:
[1]As defined in the FFA, secondary documents are discrete portions of, or input/feeder documents to, primary documents. Secondary documents are subject to review and comment by the EPA, ADEQ, and ADWR and may include AF responses; however, final resolution and concurrence is reserved until the corresponding primary document is completed.

3.2 Summary of Site Characteristics

This section provides an overview of the assessments conducted during the Supplemental RI to identify source areas and characterize contamination in groundwater at LF004. Contaminant mass estimates in this section are based on updated calculations in the FFS using more recent data. This summary presents the following information:

- Site geology and hydrogeology
- Quantity, types, and concentrations of hazardous substances
- Estimated volumes of contaminants
- Lateral and vertical extents of contamination
- Mobility of identified contaminants
- Potential surface and subsurface pathways of contaminant migration

The OU-1 ROD provides supporting information on the existing LF004 selected remedy.

3.2.1 Site Geology and Hydrogeology

The hydrogeology of LF004 is described in the FFS (AMEC Environment & Infrastructure, Inc. [AMEC], 2013a) and the *Final Supplemental RI* (URS Corporation [URS], 2010c), and can be summarized as a complex stratified system with local vertical interconnections. The relevant site-specific geology falls within the Upper Unit and the uppermost portion of the Middle Unit. The Upper Unit stratigraphic profile (0-263 feet [ft] below ground surface [bgs]; approximately 1,340 to 1,077 ft above mean sea level) is a heterogeneous mix of alternating fine-grained and coarse-grained deposits. The base of the Upper Unit, referred to regionally as the “leaky aquitard”, was encountered during well installation activities at LF01-W17D (installed in

November 2009) at a depth of 260 ft bgs. Previous studies have characterized this layer as a leaky aquitard because it is not continuous on a regional scale. The Middle Unit consists largely of weakly consolidated silt, siltstone, silty sand, and gravel with locally-occurring moderately to well cemented siltstone.

Two main aquifers can be distinguished: a shallow unconfined aquifer located in the Upper Unit and a deeper confined aquifer located in the Middle Unit. The Middle Unit aquifer is the primary source of groundwater used regionally.

Historically, groundwater levels in the vicinity of the former Williams AFB have fluctuated as groundwater demands and pumping have increased and decreased. Static groundwater elevations in the Upper Unit circa 1900 were reported to be approximately 80 ft bgs near the former Williams AFB. By 1976, extensive water demand had reportedly resulted in substantial drawdown (approximate water level of 400 ft bgs) of the water table at the former Williams AFB. Regional water levels began to recover in 1978 following the decline, resulting in rising water levels at LF004 (AMEC, 2013a).

Since July 1995, water levels in the Upper Unit at LF004 have risen at an average rate of 3.6 ft/year. The rate of increase was higher with an average increase of 5.0 ft/year from July 1995 through April 2000. Between April 2000 and September 2003, the average rise of groundwater levels was 4.3 ft/year. Since September 2003, there has been a noticeable decrease in the rate at which groundwater levels are rising. Between September 2003 and May 2009, groundwater levels at LF004 increased at an average rate of 2.4 ft/year. From July 2008 through November 2011 the groundwater levels increased at an average rate of 1.4 ft/year. From November 2011 through November 2012 the groundwater levels increased an average of 0.8 ft (AMEC, 2013d). As of November 2012, the static groundwater levels at LF004 monitoring wells ranged from 128 to 155 ft below the top of casing (AMEC, 2013d).

Groundwater surveys conducted in 1981-83 and 1991-92 indicated that although water levels had continued to rise in many nearby wells, levels measured in wells representing the Middle Unit remained constant at about 1,050 ft above mean sea level or approximately 290 ft bgs. Recent water level measurements indicate the aquifer in the Upper Unit occurs under unconfined conditions, while the piezometric data for the uppermost few feet of the Middle Unit aquifer suggest it is under semi-confined conditions. The water level data for well LF01-LA03(D), screened in the Middle Unit aquifer, indicate the potentiometric surface has rebounded to an elevation above the overlying aquitard, suggesting semi-confined conditions (AMEC 2013a).

At LF004, all contaminated groundwater is contained within the Upper Unit. The Upper Unit aquifer extends from the water table (approximately 128 to 155 ft bgs within the LF004 groundwater monitoring network) to approximately 260 ft bgs. The hydraulic properties of the saturated portion of the Upper Unit have been characterized based on aquifer testing conducted as part of the Supplemental RI and exhibit decreasing hydraulic conductivities as follows:

- The shallow screened interval of the Upper Unit (monitoring wells screened from approximately 110 to 160 ft bgs) has a hydraulic conductivity of 35.20 feet per day (ft/d) based on a pumping rate of approximately 20 gallons per minute (gpm).

- The middle screened interval of the Upper Unit (monitoring wells screened from approximately 160 to 200 ft bgs) has a hydraulic conductivity of 12.52 ft/d based on a pumping rate of approximately 10 gpm.
- The deep screened interval of the Upper Unit (monitoring wells screened from approximately 200 to 240 ft bgs) has a hydraulic conductivity of 3.72 ft/d based on a pumping rate of approximately 5 gpm.

The LF004 FFS provides further information on the aquifer testing results (AMEC, 2013a).

The hydraulic relationship between the Upper Unit and the Middle Unit is not well understood because data for the Middle Unit aquifer is limited. The wells installed in the Middle Unit in 1986 have been decommissioned with the exception of LF01-LA03(D). Comparison of water levels in wells screened in the shallow and deep portions of the Upper Unit indicate there is a downward vertical gradient at LF004; however, lithologic and piezometric data suggest the aquitard limits hydraulic communication between the Upper and Middle Unit aquifers.

3.2.2 Soil Gas Contamination at LF004

Results from soil samples analyzed during the Supplemental RI did not identify a specific VOC source area. All VOC detections were very low; the maximum PCE and TCE detections reported in soil were 14 micrograms per kilogram (µg/kg) and 3 µg/kg, respectively, at BH1401, 120 ft bgs. Both of these detections are orders of magnitude less than the Arizona Residential Soil Remediation Levels (ADEQ, 2007) and EPA residential soil Regional Screening Levels (RSLs) for PCE and TCE (EPA, 2013a). Figure 3-2 shows the TCE and PCE results for soil samples collected during the Supplemental RI. The Supplemental RI identified four distinct areas with PCE and TCE concentrations in shallow soil gas (i.e., 0 to 15 ft bgs) at or around LF004. These areas include the vicinity of the former aboveground storage tank (AST) northeast of LF004; the southeastern portion of LF004 in the vicinity of a trench feature identified northwest of LF01-W19; south of the ASU Bee Lab Annex; and the northwest corner of LF004. Figure 3-2 shows the extent of PCE and TCE contamination in soil gas identified during the Supplemental RI.

The highest shallow soil gas concentrations of PCE and TCE were found near the former AST area. The highest TCE concentration observed in shallow soil gas at the former AST area was 26 milligrams per cubic meter (mg/m^3) at sample location PH1250, approximately 80 ft southeast of the former AST. The highest TCE concentration observed in the former AST area is at least an order of magnitude higher than the maximum concentrations observed at the two areas within LF004 listed above. TCE was not observed south of the ASU Bee Lab Annex. The highest PCE concentration observed in shallow soil gas at the former AST area was 4.6 mg/m^3 at sample location PH1266, approximately 50 ft west of the former AST. The highest PCE concentration observed in the former AST area is similar to the highest concentration observed at the southeastern portion of the landfill (northwest of LF01- W19) and within the same order of magnitude as the maximum concentrations observed south of the ASU Bee Lab Annex and at the northwest corner of LF004.

The highest TCE concentration observed in shallow soil gas within the southeastern portion of LF004 (northwest of LF01-W19) was 2.7 mg/m^3 (PH1414) and the highest PCE concentration was 4.5 mg/m^3 (PH1412).

TCE was not detected in the area directly south of the ASU Bee Lab Annex. The maximum PCE concentration observed in shallow soil gas from the area directly south of the ASU Bee Lab Annex was 2 mg/m^3 (PH1105) (Figure 3-2).

TCE was not detected above 1 mg/m^3 in shallow soil gas within the northwest corner of LF004. The maximum PCE concentration detected in shallow soil gas from the northwest corner of LF004 was 2.9 mg/m^3 (PH1343) (Figure 3-2).

The maximum deep soil gas TCE result, 76 mg/m^3, was at a depth of 120 ft bgs at boring BH1207, located in the former AST area southeast of the tank. The depth interval for deep soil gas samples ranged from 15 ft bgs to the water table (128-155 ft bgs). The maximum deep boring soil gas TCE detection is approximately three times the maximum shallow soil gas TCE detection. The maximum deep soil gas PCE result, 31 mg/m^3, was at a depth of 140 ft bgs at boring BH1402, located in the southeastern portion of the landfill. The maximum deep boring soil gas PCE detection is an order of magnitude greater than the maximum shallow soil gas PCE detection.

TCE concentrations by depth in the former AST area are depicted on Figure 3-3. As shown on the figure, concentrations greater than 15 mg/m^3 of TCE were observed from the shallow subsurface to directly above the saturated zone, with the highest concentrations located directly above the groundwater. These results are indicative of a TCE source area potentially contributing to groundwater contamination.

PCE concentrations by depth in the former AST area are indicated by data presented on Figure 3-2. Concentrations up to 10 mg/m^3 (BH1208 at 120 ft bgs) were observed from the shallow subsurface to directly above the saturated zone, with the highest concentrations generally located directly above the groundwater. While PCE concentrations at the former AST area are generally an order of magnitude lower than TCE concentrations, the similar distribution of PCE contamination also indicates a potential PCE source area which may contribute to groundwater contamination.

Generally, as shown on Figure 3-2, the extent and magnitude of soil gas impacts in the southeast landfill area are less extensive than observed for the former AST area. The elevated concentrations of PCE and TCE at BH1402, 31 mg/m^3 and 5.8 mg/m^3, respectively at 140 ft bgs, combined with the distribution of groundwater contamination (see Section 3.2.3) in the southeast landfill area, make it reasonable to link the southeast landfill area near BH1402 with the observed downgradient groundwater concentrations.

Tables A-1 and A-2 in Appendix A summarize shallow and deep soil gas contaminants from the supplemental RI. The shallow (0-15 feet bgs) soil gas samples were analyzed in a field laboratory by SW8021B (modified) for PCE, TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and trans-1,2-dichlroroethene (trans-1,2-DCE). Deep soil gas samples were analyzed for VOCs at a

laboratory by Method TO-14A or TO-15. Tables A-1 and A-2 support that PCE and TCE are the primary VOC contaminants in soil gas at LF004.

3.2.3 Groundwater Contamination at LF004

During the Supplemental RI, groundwater screening samples were collected from 21 on-site deep soil borings and three off-site borings located southeast of LF004. Two contaminants, PCE and TCE, exceeded EPA drinking water MCLs and Arizona aquifer water quality standards (AWQS). The EPA MCLs and the Arizona AWQSs for PCE and TCE are both 5 micrograms per liter [µg/L] so the remainder of this section refers to MCLs.

TCE was detected in 20 of 24 samples with results exceeding the drinking water MCL (5 µg/L) in 13 samples, all located on-site. TCE was detected in one of the three off-site samples with a TCE concentration (0.24 µg/L) less than the MCL. The maximum TCE concentration (89.0 µg/L) was located in the former AST area southeast of the AST (Figure 3-4).

PCE was detected in 20 of 24 samples with results exceeding the drinking water MCL (5 µg/L) in 15 samples, all located on-site. PCE was detected in one of the three off-site samples with a PCE concentration (0.79 µg/L) less than the MCL. The maximum PCE concentration (40 µg/L) was located southeast of LF004 adjacent to monitoring well LF01-W19 (Figure 3-4).

In accordance with the OU-1 ROD, groundwater monitoring has been conducted and presented in groundwater monitoring reports, the most recent of which is for the sampling completed in November 2012. Consistent with the contaminants of potential concern (COPCs) identified in the OU-1 ROD, LF004 groundwater sample analyses are conducted for VOCs and inorganics in order to monitor groundwater conditions including contaminant concentrations, concentration trends, contaminant distribution, and potential contaminant migration. Recommendations are provided in the groundwater monitoring reports for additions or modifications to the monitoring program as needed. PCE and TCE continue to be the only volatile organic compounds (VOCs) detected above the MCLs. The peak PCE concentration detected was 113 µg/L at LF01-W19 in May 2009. The peak TCE concentration detected was 97.6 µg/L at LF01-W17 in July 2008. During the November 2012 groundwater monitoring event, PCE was detected in groundwater samples at 10 monitoring well locations above the PCE MCL. The highest PCE detection observed in 2012 was 86 µg/L at LF01-W19 in the middle screened interval. In November 2012, TCE was detected in groundwater samples collected at eight monitoring well locations above the MCL. The highest TCE detection observed in 2012 was 35 µg/L at LF01-W17 in the middle screened interval. Other VOCs detected in November 2012, all at concentrations below applicable MCLs, include acetone, 1,1-dichloroethene, methyl ethyl ketone, methylene chloride, chloroform, 1,2,3-trichlorobenzene, naphthalene, dichlorodifluoromethane, bromodichloromethane, 1,1-dichloroethane, carbon tetrachloride, 1,2-dichloropropane, and trichlorofluoromethane (AMEC, 2013d).

Figures 3-5 and 3-6 present a depiction of the PCE and TCE plumes for the November 2012 monitoring event (AMEC, 2013a). The figures represent the horizontal and vertical extent of PCE and TCE groundwater contaminant plumes based on detections reported for LF004 groundwater monitoring wells from three specific depth intervals. The three depth intervals,

shallow, middle, and deep, range approximately from 110 to 160, 160 to 200, and 200 to 240 ft bgs respectively. As shown on Figures 3-5 and 3-6, in some cases the PCE and TCE MCLs are exceeded in more than one depth interval at a well location.

The FFS provides a series of multiple plume interpretation maps showing the development of the lateral distribution of PCE/TCE plumes over time. These maps show that the PCE and TCE plumes have grown since 2001 and expanded to the south and east. The PCE plume area exceeding the MCL was approximately 3.8 acres in 2001 and 75.4 acres in the middle depth interval in November 2012 (AMEC, 2013d). Similarly, the TCE plume area exceeding the MCL was approximately 0.4 acres in 2001 and 50.8 acres in the middle depth interval in November 2012 (AMEC, 2013d). In addition to groundwater contaminant transport, the increase in plume sizes is partially associated with the addition of monitoring wells that provide more complete characterization of the plume area. More significantly, rising groundwater levels (see Section 3.2.1) are suspected to have had an effect on plume size as groundwater came into contact with TCE and PCE in deep vadose zone soil gas as identified during the Supplemental RI.

Although the size of the TCE and PCE footprints above the MCL of 5 µg/L in the M zone monitoring wells have increased over time, TCE concentrations have been progressively decreasing in the S, M, and D zone monitoring wells since around January 2009, July 2008, and November 2009, respectively (AMEC, 2013d). PCE concentrations have been progressively decreasing in the S, M, and D zone monitoring wells since around November 2009, January 2009, and November 2009, respectively (AMEC, 2013d). Figures 3-7 and 3-8 show these decreasing trends through depth-specific groundwater concentration trends for PCE and TCE over time.

Table 4-3 from the OU-1 ROD, provided in Appendix A, summarizes detected groundwater contaminants from the historic groundwater monitoring data available prior to the OU-1 ROD. Table A-3 provides summary information for COCs/COPCs identified from the November 2012 semiannual groundwater monitoring event (AMEC, 2013d) and from historical groundwater monitoring completed from 2000 through 2012. November 2012 groundwater monitoring data are the most current published data for LF004. November 2012 groundwater monitoring data are appropriate and sufficient to support remedy selection since they are consistent with the basis for evaluation of remedial alternatives in the OU-1 FFS and the groundwater contaminant distribution maps provided in the OU-1 ROD Amendment (Figures 3-5 and 3-6). Table A-3 supports that PCE and TCE are the primary VOC contaminants in groundwater at LF004.

3.2.4 Contaminant Mass at LF004

Contaminant mass estimates provided in this section are from the FFS (AMEC, 2013a). Upper and lower-end mass estimates for PCE and TCE near LF004 (including the former AST area) were developed based on assumptions regarding the distribution of contaminants within the saturated and unsaturated zones. For the upper-end estimates, the contaminant mass is presumed to reside in a 120-ft saturated thickness that has the same plume configuration with depth and in a 140-ft unsaturated thickness that has a decreasing plume configuration with depth. For the lower-end estimate, the contaminant mass is presumed to reside in a 120-ft

saturated thickness that has a decreasing plume configuration with depth and a 20-ft unsaturated thickness that has the same plume configuration with depth.

The total PCE mass near LF004, including the AST area, is estimated to be between 217 and 661 lbs (16 to 49 gallons). The PCE mass in the saturated zones is estimated to be between 150 and 219 lbs (11-16 gallons), and the PCE mass in the unsaturated zones is estimated to range between 67 and 442 lbs (5 to 33 gallons) (AMEC, 2013a).

The total TCE mass near LF004, including the AST area, is estimated to be between 143 and 533 lbs (12 to 44 gallons), the TCE mass in the saturated zones is estimated to be between 81 and 118 lbs (7-10 gallons), and the TCE mass in the unsaturated zones is estimated to range between 62 and 415 lbs (5 to 34 gallons) (AMEC, 2013a).

3.2.5 Contaminant Fate and Transport

In subsurface soil, the most likely potential future routes of VOC migration are partitioning of VOCs to soil gas (and subsequent movement in the vapor phase) and soil-to-groundwater (dissolution) of VOCs (and subsequent movement in the groundwater phase). As groundwater levels continue to rise, the volume of contaminants (absorbed to vadose-zone soils) that contact groundwater will increase and could result in additional dissolved contaminant mass. If contaminated soil is unearthed, VOCs could migrate as vapors or in fugitive dust emissions, or be carried away in surface water. However, it is unlikely that soil contaminants would reach the surface in the soil phase given the depth of the contamination. Additionally, soil data indicates only low concentrations of contaminants are present in soil, suggesting that these migration pathways are not significant.

In soil gas, VOCs can partition back to the soil phase (and be rendered relatively immobile), or partition to groundwater. Partitioning from the vapor phase to the dissolved phase will accelerate as groundwater levels rise and encounter VOCs in soil gas. Contaminants in soil gas can also move via diffusion and dispersion and may migrate to ambient or indoor air. PCE and TCE can be quite persistent in soil gas at depth. Degradation of PCE/TCE in the vapor phase is not significant at depth in the absence of sunlight. If there is a groundwater plume present, contaminants in the plume can continue to partition to the soil gas for decades. Likewise, contaminants in soil gas can partition to groundwater near the groundwater table. Given the historical increase in groundwater concentrations as the groundwater elevations rose, the latter relationship between soil vapor and groundwater is more likely.

In groundwater, the most likely potential routes of future contaminant migration are advection, diffusion, and dispersion, including possible migration to greater depths and deeper aquifers. Contaminants in groundwater can also partition to the soil or soil vapor phases. Partitioning to soil tends to render deep subsurface contaminants less mobile. Contaminants in groundwater can also eventually discharge to surface water via a spring or seep, but this is unlikely at LF004 given the depth of contamination and absence of any discharge points in the vicinity of the former Williams AFB.

Since the PCE and TCE releases in the LF004 area likely occurred between 1941 and 1993, it is evident that PCE and TCE are persistent at LF004, including in groundwater. Once PCE and TCE have entered the groundwater, they tend to persist, depending on environmental conditions. Biological degradation occurs only under anaerobic conditions. PCE, TCE, and their degradation products have been documented to persist in aquifer environments in excess of 30 years (Deutsch, 1997). This is consistent with Supplemental RI results; PCE and TCE were found extensively in groundwater at LF004 and are likely the result of decades-old releases. Natural attenuation parameter data collected in groundwater sampling events from 2008-2009 indicate subsurface conditions are not amenable for anaerobic biological degradation of PCE and TCE (AMEC, 2013a). The general lack of PCE/TCE degradation products such as cis-1,2-DCE at the site support the concept that natural attenuation is not occurring at a significant rate at LF004. The decreasing trends of PCE and TCE concentration from 2009 to 2012, as shown in Figures 3-7 and 3-8, are likely the result of dilution or dispersion rather than degradation.

3.3 Existing LF004 Selected Remedy

The OU-1 ROD (AFBCA, 1994) was signed in April 1994 following the publication of the OU-1 Proposed Plan (IT, 1993a). The LF004 selected remedy included a permeable cap to limit soil exposure and control natural erosion processes; an interceptor trench around the perimeter of the capped area for collection and routing of stormwater runoff; a perimeter fence and warning signs to limit access and provide notification for the landfill cap; post-closure care for 30 years to include cover maintenance and inspections, groundwater monitoring, maintenance of monitoring equipment; and land use restrictions to protect the integrity of the landfill cover and the groundwater monitoring system. The permeable cap and related components were installed in 1995. The purpose of the LF004 existing remedy is to provide post-closure care for the landfill and to prevent human contact with surface soil potentially contaminated with dieldrin and beryllium at concentrations that were determined to pose unacceptable risks to human health and the environment. At the time of the OU-1 ROD, there were no identified soil gas or groundwater impacts that required remedial action at LF004.

4.0 BASIS FOR THE ROD AMENDMENT

This section summarizes the information that prompted and supports fundamentally changing the LF004 remedy selected in the OU-1 ROD.

4.1 Post-Closure Groundwater Monitoring

Post-closure groundwater monitoring at LF004 has consistently detected PCE and TCE. PCE was first detected in groundwater samples at concentrations exceeding the MCL of 5 µg/L in July 1995. TCE was first detected at concentrations above the MCL of 5 µg/L in September 1997. Groundwater samples collected in October 2005 (120 µg/L PCE in LF01-W19) and July 2008 (97.6 µg/L TCE in LF01-W17) were the highest concentrations of PCE and TCE detected since monitoring began. These two wells continue to have the highest concentrations at the site; however, current (November 2012) concentrations (86 µg/L PCE in LF01-W19 and 35 µg/L TCE in LF01-W17) are less than the peak concentrations (see Section 3.2.3).

4.2 Supplemental Remedial Investigation

A supplemental RI in 2010 further investigated PCE and TCE groundwater contamination. Details of the Supplemental RI are documented in the Final Supplemental RI Report (URS, 2010c). The following subsections summarize the Supplemental RI activities.

4.2.1 Source Area Characterization

The Supplemental RI collected soil and shallow soil gas samples to identify potential groundwater contamination source areas. Based on shallow sampling results, deep soil borings were installed for additional soil gas sampling. The investigation identified four distinct areas of PCE and TCE contamination in soil gas exceeding 1 mg/m^3, two of which correspond to areas of groundwater contamination (see Section 3.2.2).

4.2.2 Groundwater Characterization

During the Supplemental RI, multiple groundwater sampling events delineated groundwater contamination collocated with areas where soil gas contamination was observed. The investigations identified two areas of peak VOC concentrations in groundwater with a contaminant plume that surrounds both areas. Section 3.2.3 and the LF004 2012 Annual Groundwater Monitoring Report (AMEC, 2013d) provide further information on the most recent groundwater sampling results. As described in Section 3.2.5, sampling results for natural attenuation parameters did not indicate the aquifer at LF004 is amenable to anaerobic biological degradation of PCE and TCE.

4.3 Screening Level Human Health Risk Assessment

A screening-level human health risk assessment was completed for LF004 in the *Final Supplemental RI Report* (URS, 2010c). Although the screening level risk assessment in the Final Supplemental RI discussed potential exposure to soil gas and groundwater, it only provided screening level estimates of risk for soil gas. For completeness, the FFS augmented

the Supplemental RI with screening-level estimates of risk related to groundwater. This section summarizes the screening level risk estimates for soil gas and groundwater presented in the Supplemental RI and FFS, respectively. In Section 4.4 the soil gas screening level estimates of risk have been updated to consider current (November 2013) EPA RSLs for both carcinogenic and noncarcinogenic risk.

If groundwater of the Upper Unit is used for domestic or agricultural purposes in the future, exposure to contaminants in the groundwater via ingestion, dermal contact, and inhalation of vapors is possible. Although not a formal quantitative risk calculation, comparison of groundwater concentrations at LF004 to EPA RSLs provides a frame of reference for the magnitude of the health risk. The EPA tap water RSLs for PCE and TCE represent concentrations in tap water that pose a $1x10^{-6}$ Incremental Lifetime Cancer Risk (ILCR) under a generic, typically conservative set of exposure assumptions. The tap water RSL for PCE is 9.7 µg/L (EPA, 2013b). The maximum detected concentration of PCE in November 2011 (the data evaluated in the FFS) was 71.9 µg/L, indicating that the ILCR associated with PCE in this sample is less than $1x10^{-5}$ (which would occur at a concentration of 97 µg/L). The tap water RSL for TCE is 0.44 µg/L (EPA, 2013b). The maximum detected concentration of TCE in November 2011 was 50.3 µg/L, indicating that the ILCR associated with TCE in this sample is more than $1x10^{-4}$ (which would occur at a concentration of 44 µg/L).

ILCRs are additive and typically calculated based on 95th percent upper confidence limit or mean exposure point concentrations (EPCs) rather than maximum concentrations, which can overestimate the risk. Using the EPC approach, the risks associated with the domestic use of groundwater were estimated in the FFS. The PCE and TCE EPCs from the November 2011 groundwater monitoring data set were calculated using EPA's ProUCL software. For PCE and TCE, the EPCs are 9.4 and 7.7 µg/l, respectively. Utilizing the same set of exposure assumptions as used for the RSLs (EPA, 2013d), the majority of the risk is contributed by TCE with an ILCR of $2x10^{-5}$ while the PCE ILCR is $1x10^{-6}$. The combined estimated ILCR for PCE and TCE based on the calculated EPCs is $2x10^{-5}$.

Using the PCE and TCE EPCs, the non-cancer risk or hazard associated with domestic use of groundwater at LF004 were estimated for the individual compounds and totaled assuming that both PCE and TCE act upon the same target tissues. The sum of the individual PCE and TCE hazards results in a hazard index [HI]) of 3.3 with TCE contributing the majority of the hazard (HI = 3.0) while PCE contributed 0.3 to the total HI.

California Environmental Protection Agency (Cal EPA) Human Health Screening Levels (CHHSLs) (Cal EPA, 2005) and California Regional Water Quality Board (CRWQB) environmental screening levels (ESLs) (CRWQB, 2008) for vapor intrusion concerns for PCE and TCE were used in the screening level risk assessment for soil vapor presented in the *Final Supplemental RI* (URS, 2010c). Cal EPA CHHSLs and CRWQB ESLs are available for shallow soil gas (less than 5 ft below a building or the ground surface) that are applicable to a slab-on-grade residential or commercial/industrial building. CRWQB ESLs are available for groundwater in addition to shallow soil gas. The use of these screening levels is generally conservative when applied to deeper soil due to additional attenuation that occurs between the deep soil gas and

the point of exposure. At LF004 the highest soil gas concentrations are found near the water table, more than 100 ft bgs.

The conclusions of the screening-level human health risk assessment (URS, 2010c and AMEC, 2013a) indicate:

- PCE and TCE migration via soil gas from the subsurface to indoor air represents the primary potentially complete exposure pathway for a future indoor worker and a future resident.
- Vapor intrusion to indoor air represents a potentially unacceptable future human health risk in the vicinity of the AST where there are currently no habitable structures. The highest detected concentrations of PCE (4.6 mg/m^3) and TCE (26 mg/m^3) in shallow soil gas in the vicinity of the former AST are equivalent to an estimated screening level risk in the range of $3x10^{-5}$ to $8x10^{-5}$ for a slab-on-grade residential building with TCE contributing most of the risk. Maximum detected TCE concentrations in the northwest (0.44 mg/m^3) and southeast (2.7 mg/m^3) portions of LF004 are one to two orders of magnitude less than maximum TCE concentrations in the former AST area, while maximum PCE concentrations in the northwest (2.9 mg/m^3) and southeast (4.5 mg/m^3) portions of LF004 are a similar order of magnitude to the former AST area. Based on these maximum concentrations, the northwest and southeast portions of LF004 pose a screening level risk to future residential building occupants in the range of $7x10^{-6}$ to $3x10^{-5}$. TCE was not detected in soil gas in the vicinity of the ASU Bee Lab Annex and the maximum detected PCE concentration (2 mg/m^3) was of the same order of magnitude as the other areas. Based on the maximum PCE concentration, the ASU Bee Lab Annex area poses a screening level risk to future residential building occupants in the range of $5x10^{-6}$ to $1x10^{-5}$.
- Vapor migration of PCE and TCE to ambient air or the air of a construction excavation is a potentially complete pathway of exposure for outdoor workers, construction workers, or future residents; however, the exposure potential is considered insignificant. Because of substantial dispersion in ambient air and the air of an open excavation, PCE and TCE concentrations of concern are unlikely to occur at these locations. Attenuation factors for vapor migration to indoor air are in the range of 10 to 100. The additional influence of dispersion in ambient air would be expected to result in attenuation factors another one to two orders of magnitude higher than indoor air attenuation factors. Such attenuation factors would result in exposure concentrations that are below screening levels such as the EPA indoor air RSLs for residential exposure.
- If groundwater of the Upper Unit is used for domestic or agricultural purposes by workers or residents at LF004 in the future, exposure to PCE and TCE in groundwater at concentrations exceeding the drinking water MCLs is also possible and poses a combined estimated ILCR for PCE and TCE of $2x10^{-5}$ and an HI of 3.3.

4.4 Screening Level Human Health Risk Assessment Update for Soil Gas

The screening level human health risk assessment for soil gas completed in the Supplemental RI did not address noncarcinogenic risk and used California screening levels which are not

directly applicable for use in Arizona. The screening level human health risk assessment for soil gas was updated with the current EPA RSLs (EPA, 2013c) for residential indoor air using a procedure similar to that performed in the Supplemental RI. The maximum TCE and PCE soil gas concentrations detected at each of the four areas identified in the Supplemental RI were compared to the residential indoor air RSLs with an applied attenuation factor of 0.01 between soil gas and indoor air. The attenuation factor of 0.01 corresponds with the 95th percentile attenuation factor for slab-on-grade residences specified in EPA's Vapor Intrusion Database (EPA, 2012). Table 4-1 presents the results of this analysis for each of the four areas.

Table 4-1 Updated Soil Gas Screening Level Risk1

	RSL		AST Area			Northwest LF Area		
	C	NC	Max	ILCR	HQ/HI	Max	ILCR	HQ/HI
	mg/m^3	mg/m^3	mg/m^3			mg/m^3		
TCE	0.00043	0.0021	26	6.0x10^{-4}	120	0.44	1.0x10^{-5}	2.1
PCE	0.0094	0.042	4.6	4.9x10^{-6}	1.1	2.9	3.1x10^{-6}	0.7
Combined				6.0x10^{-4}	120		1.3x10^{-5}	2.8
	RSL		Southeast LF Area			Bee Lab Area		
	C	NC	Max	ILCR	HQ/HI	Max	ILCR	HQ/HI
	mg/m^3	mg/m^3	mg/m^3			mg/m^3		
TCE	0.00043	0.0021	2.7	6.3x10^{-5}	13	<0.2[3]	<4.7x10^{-6}	<1.0
PCE	0.0094	0.042	4.5	4.8x10^{-6}	1.1	2	2.1x10^{-6}	0.5
Combined				6.8x10^{-5}	14		<2.6x10^{-6}	<1.5

Notes:
[1]Risk calculations include an attenuation factor of 0.01 between soil gas and indoor air.
[2]The combined hazard index assumed hazard quotients for TCE and PCE are additive based on toxicity to similar organs/systems.
[3]TCE was not detected south of the Bee Lab annex. The detection limit is used in the risk calculations.
AST – above ground storage tank
C – carcinogenic
HI – hazard index (combined effect of multiple compounds)
HQ – hazard quotient (individual compounds)
ILCR – incremental lifetime cancer risk
LF – landfill
mg/m3 – milligrams per cubic meter
NC – noncarcinogenic
RSL – Regional Screening Level (indoor air) (EPA, 2013c)
TCE – trichloroethene
PCE – tetrachloroethene

Using the RSLs as a basis for an updated human health screening level risk assessment for the soil gas to indoor air pathway, the following conclusions are reached:

- The AST area poses an ILCR of 6.0x10^{-4}, which is greater than the 1x10^{-6} to 1x10^{-4} risk management range. The HI of 120 also exceeds an HI of 1.0 indicating that shallow soil gas at the AST area poses a potentially unacceptable human health risk based on maximum concentrations detected during the Supplemental RI.
- The northwest landfill area poses an ILCR of 1.3x10^{-5} and an HI of 2.7. The ILCR is within the risk management range. The HI, calculated based on maximum concentration exceeds 1.0.

- The southeast landfill area poses an ILCR of $6.8x10^{-5}$ and an HI of 14. The ILCR is within the risk management range. The HI, calculated based on maximum concentration exceeds 1.0.
- The area south of the Bee Lab has an ILCR of less than 2.6x10-5 and an HI of less than 1.5. The ILCR is within the risk management range. The HI, calculated based on maximum concentration may exceed 1.0 although TCE was not detected and there is uncertainty associated with TCE soil gas detection limits that do not allow demonstration of an HI lower than 1.0.

5.0 DESCRIPTION OF EXISTING AND AMENDED REMEDIES

Groundwater and soil gas alternatives were not originally evaluated in the OU-1 FS, since available data at the time indicated no remedy was necessary. In response to the determination that the originally selected remedy needed revisions to address soil gas and groundwater contamination, the LF004 FFS was completed to evaluate soil gas and groundwater alternatives (AMEC, 2013a). The LF004 FFS identified and evaluated five soil gas and groundwater alternatives for as follows:

- Alternative 1. No Action
- Alternative 2. In-Situ Air/Ozone Sparging with SVE
- Alternative 3. Enhanced Bioremediation with Limited SVE
- Alternative 4. Hydraulic Control and Limited SVE
- Alternative 5. IWAS, Oxidation, and SVE

Alternative 1 is the No Action alternative. No Action was carried through the evaluation process to serve as a baseline comparison for the considered remedial technologies.

Alternative 2 includes in-situ air and/or ozone sparging to treat groundwater contamination and SVE to treat contaminated soil gas. Air sparging is the injection of air beneath the water table. As it bubbles through the contaminant plume, volatile contaminants in the dissolved phase leave the water and enter the air, which is captured and treated at the surface, if necessary. The same injection equipment could be used to inject gaseous ozone beneath the water table. Ozone is a strong chemical oxidant that degrades large organic molecules such as the contaminants present at the site, and would also increase the dissolved oxygen content of the groundwater. Sparging wells would intercept and treat the most contaminated groundwater as it migrates, and SVE wells would extract contaminants volatilized from the groundwater by the sparging wells, as well as residual contamination in the unsaturated zone soils and soil gas.

Alternative 3 includes enhanced bioremediation to treat contaminated groundwater and SVE to treat soil gas. Enhanced bioremediation is the process of modifying existing conditions to promote biological activity among bacteria that feeds off of contamination present at the site. This can be achieved by introducing strains of bacteria that are more effective at degrading contaminants than those that are present at the site, introducing food sources to promote activity, or modifying physical or chemical characteristics (pH, temperature) to create an environment that is more hospitable to bacterial growth. Injection and extraction wells would circulate the most contaminated groundwater while adding material such as emulsified vegetable oil to create the environmental conditions necessary for bacteria in the groundwater to degrade the contaminants. SVE wells would extract residual contamination from unsaturated zone soils and soil gas for treatment.

Alternative 4 includes hydraulic control to restrict migration of contaminated groundwater and SVE to treat soil gas. Hydraulic control is a term that refers to a number of technologies that can be implemented to redirect or prevent groundwater migration, and typically include a form of

groundwater extraction. Groundwater extraction wells are installed in an arrangement to prevent the migration of contaminated groundwater beyond the wells and to capture and extract contaminated groundwater to be treated by an ex-situ technology on the surface. Extraction wells would intercept and extract the most contaminated groundwater as it migrates. SVE wells would extract residual contamination from unsaturated zone soils and soil gas for treatment and subsequent discharge to the atmosphere.

Alternative 5 includes IWAS and oxidation to treat contaminated groundwater and SVE to treat soil gas. Air stripping is the process of aerating groundwater to transfer contaminants from the dissolved phase into the air, which can then be treated. IWAS is the process of aerating groundwater inside of an extraction well, minimizing the need for above-ground groundwater treatment infrastructure. IWAS wells use a combination of mechanisms to simultaneously treat groundwater and unsaturated soil contamination. To shorten the time frame for operating the IWAS wells, oxidants such as ozone and hydrogen peroxide could be added to degrade the contaminants in place. The SVE system would extract contaminants stripped from the groundwater by the IWAS wells, as well as residual contamination in the unsaturated zone soils and soil gas.

Based on the FFS evaluation, Alternative 5 was identified in the Amended Proposed Plan as the preferred alternative and is the soil gas and groundwater Selected Remedy in this ROD Amendment. Alternative 5 is selected because it will achieve applicable or relevant and appropriate requirements (ARARs) in the shortest amount of time and uses the technology with the most certainty of achieving the predicted results at the site. It is implementable and poses easily managed risks to workers and visitors to the site for the shortest period of time. It is a permanent solution that allows unrestricted use of areas outside the LF004 cap in the future, and the technology is the most suited to the scale and conditions of the site. Alternative 1 would not achieve ARARs at LF004 for hundreds of years. Alternative 2, 3, and 4 would require 30 years of active remediation to achieve ARARs, while Alternative 5 is predicted to achieve ARARs with 10 years of active remediation. Remediation wells utilizing air sparging are a technology element of FFS Alternative 2 that is retained for potential implementation as part of Alternative 5 to augment IWAS and oxidant technologies toward achieving cleanup levels. Additional details on the alternatives are available in the LF004 FFS (AMEC, 2013a) and Amended Proposed Plan (AF, 2013).

The remainder of this section provides the Remedial Action Objectives (RAOs) for the site, describes the selected groundwater and soil gas remedy from the LF004 FFS and Amended Proposed Plan (Alternative 5: IWAS, Oxidation, and SVE), and describes the expected outcome of the remedy as a result of this OU-1 ROD Amendment. The original selected remedy was described in Section 3.3. Table 5-1 provides a side by side comparison of the existing and amended remedy components for treatment, containment or storage, and ICs. Key ARARs in terms of the original and amended selected remedies are provided in Appendix B.

Table 5-1 Comparison of Existing and Amended Remedy Components for LF004

Component	Existing LF004 Remedy, OU-1 ROD	Amended LF004 Remedy, OU-1 ROD Amendment
Treatment Components	Not applicable.	Install IWAS wells to remove PCE and TCE contaminant mass.
	Not applicable.	Install supplementary oxidant injection wells or apply oxidant directly to IWAS wells to reduce overall time/duration of treatment.
	Not applicable.	Implement air sparging and/or natural attenuation monitoring as supplemental technology components based on observed progress of IWAS and oxidant technologies.
	Not applicable.	Natural attenuation monitoring until cleanup levels are achieved for contamination outside the treatment area.
	Not applicable.	Install SVE wells to remove contaminant mass from the former AST area.
Containment or storage components	Permeable cap to limit soil exposure and control natural erosion processes; an interceptor trench around the perimeter of the capped area for collection and routing of stormwater runoff; a perimeter fence and warning signs to limit access and provide notification for the landfill cap; post-closure care for thirty (30) years to include cover maintenance and inspections, groundwater monitoring, and maintenance of monitoring equipment.	Retained.
Institutional Controls	Land use restrictions to protect the integrity of the landfill cover and the groundwater monitoring system.	IC elements of the existing remedy are retained. Until cleanup levels are achieved, additional ICs will be implemented to prevent human exposure to contaminants in soil gas and groundwater. ICs will include restrictions that limit property uses, prohibit groundwater extraction or installation of groundwater wells for other than monitoring or remediation, and require that vapor intrusion risk be assessed and/or new structures be designed and built to mitigate unacceptable vapor intrusion risk.
ARARs	Location and action-specific ARARs were identified for the landfill closure and post-closure maintenance and monitoring remedy.	ARARs established for the existing LF004 remedy are retained. In addition, chemical-specific ARARs for groundwater and soil gas COCs were identified. See Appendix B for details.

5.1 Remedial Action Objectives

The RAOs for the ROD amendment at LF004 are:

- Prevent exposure to contaminants in groundwater exceeding drinking water standards.
- Prevent exposure to contaminants in indoor air at concentrations exceeding the risk management range of $1x10^{-4}$ to $1x10^{-6}$ ILCR or a HI of greater than 1.
- Restore the groundwater to drinking water and aquifer water quality standards.

The purpose of the first two RAOs is to prevent exposures to contaminants that pose a potential human health risk. Chemical-specific health-based ARARs for groundwater, where available, were selected over calculated site-specific risk-based actions levels. For soil gas, EPA indoor air RSLs will be used as screening criteria to assess the progress of the remedy and the determination of cleanup will include a risk-based demonstration that the second RAO has been achieved. The purpose of the third RAO is to restore groundwater to concentrations that comply with applicable chemical-specific ARARs. Because these ARARs are based on protection of human health, restoration to these concentrations will address the risks identified in the baseline human health risk assessment.

The identification of groundwater cleanup levels and soil gas screening levels based on the RAOs above are documented in Tables B-2 and B-4 of Appendix B and summarized in Tables 5-2 and 5-4. The original OU-1 ROD selected remedy included a detection monitoring program using COPCs identified at LF004 as the baseline of hazardous substances to be monitored in groundwater. The OU-1 ROD identified 23 compounds as groundwater COPCs as presented in Table 5-3 and Table B-3 of Appendix B. The listed COPCs included both VOCs and inorganic compounds. Remediation goals presented in the OU-1 ROD and listed in Table 5-3 were compared to groundwater concentrations to determine the need for remedial action. At the time of the OU-1 ROD, none of the COPCs were present at concentrations that required remedial actions, but the COPC list was used as a basis for semiannual groundwater monitoring with modification of the parameters allowed in the RD/RA process. Based on the historical record of detected VOCs at LF004 since the OU-1 ROD, TCE and PCE are consistently present at concentrations that pose a potential future human health risk and exceed chemical-specific ARARs. Therefore, TCE and PCE are considered groundwater and vadose zone COCs for the site that require remedial action to achieve the RAOs. The cleanup levels for TCE and PCE in groundwater are listed in Table 5-2. The LF004 FFS identified Arizona AWQSs as the basis for some preliminary remediation goals including TCE and PCE. The Arizona AWQSs for TCE and PCE are equal to the federal MCLs. Code of Federal Regulations (CFR) Part 40 Section 300.5 establishes that only state standards that are more stringent than federal requirements are ARARs. ROD Amendment Tables 5-2, 5-3, B-2 and B-3 identify federal MCLs as the ARARs basis if a federal MCL is established and there isn't a more stringent state standard.

In addition, the common intermediate degradation products of TCE and PCE, specifically, 1,1-dichloroethene (1,1-DCE), trans-1,2-DCE, cis-1,2-DCE, and vinyl chloride have been added to Table 5-3 as COPCs. Currently, concentrations of these COPCs are below chemical-specific ARARs and TBCs for groundwater. The AF will continue to monitor for these COPCs, as well as

other groundwater COPCs identified in the OU-1 ROD, during implementation of the amended Selected Remedy. ARAR/TBC levels in groundwater at which further evaluation of COPCs will be triggered are listed in Table 5-3.

Table 5-2 List of Chemicals of Concern in Groundwater and Associated Cleanup Level

Chemical of Concern	OU-1 ROD Amendment Cleanup Level (µg/L)	Basis of Cleanup Level
Chemicals of Concern[1]		
PCE	5	Federal MCL
TCE	5	Federal MCL

Notes:
[1] PCE and TCE were contaminants of potential concern in the OU-1 ROD and are now considered chemicals of concern in this OU-1 ROD Amendment.

Table 5-3 List of Chemicals of Potential Concern in Groundwater and Associated ARAR/TBC Level

Chemical of Potential Concern	OU-1 ROD Amendment ARAR/TBC Level (µg/L)[1]	Basis of ARAR/TBC Level
Degradation Products of COCs[2]		
1,1-DCE	7	Federal MCL
cis-1,2-DCE	70	Federal MCL
trans-1,2-DCE	100	Federal MCL
Vinyl chloride	2	Federal MCL
Other COPCs from OU-1 ROD		
Acetone	12,000	EPA Tap Water RSL
Antimony	6	Federal MCL
Benzene	5	Federal MCL
Beryllium	4	Federal MCL
bis(2-ethylhexyl)phthalate	6	Federal MCL
Bromodichloromethane	80	Federal MCL
Cadmium	5	Federal MCL
Carbon Disulfide	720	EPA Tap Water RSL
Chromium	100	Federal MCL
Copper	1,300	Federal/Arizona Alert Level
Lead	15	Federal/Arizona Alert Level
Manganese	320	EPA Tap Water RSL
Methylene Chloride	5	Federal MCL
Nickel	100	Arizona AWQS
Nitrate	10,000	Federal MCL
Selenium	50	Federal MCL
Silver	71	EPA Tap Water RSL
Toluene	1,000	Federal MCL

Chemical of Potential Concern	OU-1 ROD Amendment ARAR/TBC Level (µg/L)[1]	Basis of ARAR/TBC Level
Uranium	30	Federal MCL
Zinc	4,700	EPA Tap Water RSL

Notes:
[1] Groundwater monitoring data collected during the detection monitoring program will be evaluated using the ARAR/TBC levels. Should ARAR/TBC levels be exceeded, results will be further evaluated to determine the need for changes in the remedial action or additional remedial action. ARAR/TBC levels may become cleanup levels if triggered.
[2] 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE, and vinyl chloride were added as contaminants of potential concern in this OU-1 ROD Amendment.
RSL – Regional Screening Level (indoor air) (EPA, 2013c)

Table 5-4 List of Chemicals of Concern in Shallow Soil Gas and Associated Screening Level

Contaminant	Soil Gas Screening Levels (mg/m^3)	Basis of Screening Level
Chemicals of Concern		
PCE	4.2-9.4	EPA residential noncarcinogenic and carcinogenic RSLs for indoor air with attenuation factor of 0.01 between soil gas and indoor air (EPA, 2013c)
TCE	0.21-0.43	Same as PCE

Notes:
[1] Soil gas contaminants and associated screening levels were not evaluated or presented in the OU-1 ROD.

The screening levels for soil gas presented in Table 5-4 will be used as guidelines to evaluate remedial action progress and determine the timing of a site-specific risk assessment to demonstrate achievement of the risk-based RAO. The shallow soil gas screening levels were developed using the noncarcinogenic EPA residential RSLs for indoor air and the carcinogenic EPA residential RSLs for indoor air modified to correspond to a $1x10^{-5}$ ILCR. The selected site-specific screening level considers a target cancer risk of $1x10^{-5}$ for residential receptors, because this value is within the risk management range, compliant with the NCP, and an appropriate goal at which to evaluate risk using site specific exposure assumptions to determine whether the RAO has been met. In addition, $1x10^{-5}$ ILCR is consistent with the criteria used in the State of Arizona for residential soil remediation levels. If the site-specific risk assessment performed after remedy completion proposes a final residential ILCR within the risk management range but more than $1x10^{-6}$, the justification for such a level will be presented in the risk assessment and will be subject to review and concurrence by the EPA and ADEQ. Although PCE and TCE intermediate degradation products of 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were discussed in the FFS as COPCs for soil gas, they have not been detected at concentrations that pose a potential unacceptable risk to human health. Cis-1,2-

DCE and trans-1,2-DCE were analyzed for in shallow soil gas during the Supplemental RI but not detected (URS, 2010c) (see Table A-1). 1,1-DCE and vinyl chloride were not analyzed for in the shallow soil gas screening samples but all of the degradation products were analyzed for in laboratory samples collected as part of the deep soil gas investigation. There were only sporadic detections of the degradation products trans-1,2-DCE (2 of 125 samples) and 1,1-DCE (4 of 21 samples) in deep soil gas results (see Table A-2). The AF will monitor for all of the degradation compounds and, if detected, include them in the site-specific risk assessment for soil gas and the vapor intrusion exposure pathway.

Maximum shallow soil gas concentrations south of the ASU Bee Lab Annex (<0.2 mg/m^3 TCE and 2 mg/m^3 PCE) are below the screening levels and no remedial action or restrictions are warranted. The maximum shallow soil gas TCE concentration in the northwest portion of LF004 exceeds the screening value range in one sample and is equivalent to the noncarcinogenic screening level in another (0.44 and 0.23 mg/m^3 of TCE in samples compared to 0.21 mg/m^3 screening level). The maximum shallow soil gas PCE concentration in the northwest portion of LF004 is below the screening levels. Based on the detected concentrations and limited area of impact depicted in Figure 3-2 (one sample is above screening level), no remedial action or restrictions are warranted in the northwest portion of LF004. The maximum TCE (2.7 mg/m^3) and PCE (4.5 mg/m^3) concentrations in the southeast portion of the landfill are within or above the screening level ranges and warrant restrictions to reduce or prevent human exposure to contaminants that may pose adverse risks via indoor air contaminated by chemicals volatilizing from shallow soil gas (vapor intrusion). The maximum TCE concentration (26 mg/m^3) at the former AST is more than an order of magnitude above the screening level while the maximum PCE concentration slightly exceeds the noncarcinogenic screening level (4.6 mg/m^3 in sample compared to 4.2 mg/m^3 screening level). Concentrations in this area warrant remedial action to achieve the RAOs. Until RAOs are achieved, restrictions are warranted in the AST area to reduce or prevent human exposure to contaminants that may pose adverse risks via indoor air contaminated by chemicals volatilizing from shallow soil gas (vapor intrusion).

Figures 3-5 and 3-6 show the extent of groundwater contamination subject to RAOs and associated cleanup levels for PCE and TCE, respectively, based on the November 2012 sampling data. Figure 5-1 shows the extent of soil gas contamination in the former AST area subject to RAOs based on the screening levels and the Supplemental RI data. Note that ICs presented in Section 5.1.1 will provide protection of the LF004 cover and will provide protection against vapor intrusion to indoor air in the AST area and southeast portion of LF004 until RAOs are achieved.

5.2 Description of the Amended Remedy: Alternative 5: In-Well Air Stripping, Oxidation, and Soil Vapor Extraction

The Selected Remedy for soil gas and groundwater at LF004 is Alternative 5: IWAS, Oxidation, and SVE as described in the LF004 FFS and Amended Proposed Plan with the addition of the air sparging component from Alternative 2 as a potential supplemental technology. The amended Selected Remedy will achieve cleanup levels by air stripping and extracting groundwater contaminants via IWAS wells, treating groundwater contaminants in place via

oxidant injection, and extracting soil gas contaminants via SVE. Individual processes will be applied in a sequential approach as follows:

- Until cleanup levels are achieved, ICs will be implemented to prevent human exposure to contaminants in soil gas and groundwater. Controls will include restrictions that limit property uses, prohibit groundwater extraction or installation of groundwater wells other than for monitoring or remediation, and require that vapor intrusion risk be assessed and/or new structures be designed and built to mitigate unacceptable vapor intrusion risk. For additional information see Section 5.1.1.
- Initial IWAS wells will volatilize, and extract contamination from the areas of highest PCE and TCE concentrations.
- Depending on effectiveness of the IWAS wells, supplementary oxidant injection wells or oxidant applied directly to the IWAS wells will treat contamination in place, reducing the required operation time of the IWAS wells and accelerating the time to achieve cleanup levels.
- System performance monitoring over the first few months of operation will confirm the performance and efficiency of the IWAS wells and will provide the design basis for subsequent system expansion. A conceptual layout of the complete IWAS well field and well schematic from the FFS and Proposed Plan, respectively are provided in Figure 5-2. The sequence of implementation and final layout will be presented in the Remedial Design/Remedial Action Work Plan and will differ in specific well locations and numbers from Figure 5-2 based on pre-design groundwater sampling results and additional design analysis. The extents of treatment areas requiring sequential phases of implementation are anticipated to be based on observed concentrations during initial phases of treatment.
- SVE wells will extract contamination from the former AST area and operate until it is demonstrated that the RAOs are achieved. Soil gas confirmation sampling results will be used to support the demonstration that RAOs are achieved.
- Additional IWAS wells will focus on areas where PCE and TCE exceed 20 µg/L in the remainder of the proposed treatment area. Groundwater sampling performed during new IWAS well installation, in combination with sampling results from the existing groundwater monitoring network, will delineate the areas to be treated during system expansion.
- Based on the observed progress of IWAS and oxidant technologies toward achieving cleanup levels, additional IWAS, oxidant technologies, or air-sparging may be implemented in areas of lower groundwater contamination (<20 µg/L) if attenuation by active remediation and natural attenuation processes is not proceeding as anticipated. Monitored natural attenuation may be used for certain areas of the site outside active treatment areas where cleanup levels are only slightly exceeded and concentrations will decrease as a result of mass removal in active treatment areas.
- Groundwater sampling and analysis will track the progress of the remedy effectiveness.

The selected remedy for groundwater will be implemented until the chemical-specific cleanup levels are reached, expected to be within 10-15 years. Monitoring of the groundwater remedy will be conducted until cleanup levels have been reached and then continue in accordance with existing landfill post-closure monitoring requirements. It is expected that cleanup levels will be attained for portions of the groundwater contaminant plume area as remedial action progresses and that the area exceeding cleanup levels will diminish over time. In the absence of alternative mutual agreement between the AF, EPA and ADEQ, cleanup levels will have been attained when monitoring results throughout the plume reach concentrations at or below the cleanup levels and remain below cleanup levels throughout a two year period of continued groundwater monitoring after cleanup levels were initially achieved. The AF, EPA and ADEQ may agree to termination of monitoring at specific locations or for the overall plume area based on a shorter duration or other criteria upon mutual agreement. No institutional or engineering controls will be required after the remedy has achieved RAOs other than those already required for the landfill cap.

5.2.1 Institutional Controls

ICs are a component of the LF004 amended remedy. ICs are non-engineering, non-technical mechanisms (e.g., land use controls) used to reduce or prevent human exposure to contaminants and to protect the integrity of the remedy. The LF004 amended Selected Remedy adds restrictions related to preventing exposure to contaminants in soil gas and groundwater. This section also applies to implementation of ICs that are a part of the existing LF004 remedy. The restrictions will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure. Upon demonstrating that the remedy is operating properly and successfully, federal transfer to the Bureau of Indian Affairs is currently planned so that the property may be held in trust for the Glia River Indian Community (GRIC). If this planned transfer cannot be completed for any reason, the property may be offered for public sale. Therefore, the anticipated land use will not be fully defined until the property transfer occurs. In any case, all future land uses must be consistent with and comply with the ICs as described in this section.

The existing and added ICs for the LF004 remedy are as follows:

- Use of the LF004 capped area for residential purposes, hospitals for human care, public or private schools for persons under 18 years of age, or day-care centers for children is prohibited.
- Installation of groundwater wells or extraction of groundwater from the property for any purpose other than remediation or monitoring is prohibited.
- Structures intended for occupancy within areas impacted by COCs in shallow soil gas will be (a) designed and constructed in a manner that would mitigate unacceptable risk under CERCLA and the NCP (e.g., through installation of a vapor intrusion barrier or gas collection system); or (b) evaluated for the potential for unacceptable risk prior to the erection of any new occupied structure in the same area, and mitigated for vapor intrusion in the design/construction of the structure prior to occupancy if an unacceptable risk is posed under CERCLA and the NCP.

- Activities that would limit access to the remediation and monitoring systems, interfere with the effectiveness of the remedy, or cause disturbance of any equipment or systems associated with LF004 such as the permeable cap, interceptor trench and storm water drainage systems, LF004 fencing and signs, groundwater remediation and monitoring systems, and soil vapor remediation and monitoring systems are prohibited.

Figure 5-3 shows the associated IC compliance boundaries. The compliance boundary for the existing cap IC would be the fenced area of LF004. All of Parcel N would be subject to the ICs of prohibiting groundwater wells for purposes other than monitoring or remediation, prohibiting groundwater extraction, and protecting groundwater monitoring and remediation systems. The compliance boundary for the soil gas restriction is defined as the former AST area and the southeast LF004 area where soil gas impacts exceed the shallow soil gas screening level.

Specific language is included in this ROD Amendment regarding implementation, monitoring, reporting, and enforcement of ICs. Although the AF is transferring responsibilities to the transferee and its successors by provisions to be included in the deed(s) transferring title to the property and may contractually arrange for third parties to perform any and all of the actions associated with the institutional controls, the AF is ultimately responsible for the remedy (including institutional controls) before and after property transfer. The AF will exercise this responsibility in accordance with CERCLA and the NCP. Therefore, compliance with the terms of this ROD Amendment will be protective of human health and the environment. Because the restrictions and the means for implementing the restrictions are specifically described below, it is not necessary for the AF to submit any new, post-ROD IC implementation documents, such as a land use control implementation plan, new OM&M plans, or remedial action work plan for the restrictions.

Meeting the RAOs shall be the primary and fundamental indicator of IC performance, the ultimate aim of which is to protect human health and the environment. Performance measures for ICs are the RAOs plus the actions necessary to achieve those objectives. It is anticipated that successful implementation, operation, maintenance, and completion of these measures will achieve protection of human health and the environment and compliance with all legal requirements.

Except as provided below, the AF may contractually arrange for third parties to perform any of the actions associated with ICs, although the AF is ultimately responsible under CERCLA for the successful implementation of ICs, including monitoring, maintenance, review and enforcing of ICs. Monitoring, maintenance, and other controls as established in accordance with this ROD and the appropriate transfer documents will be continued until ICs are no longer necessary. Institutional controls shall be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels as to allow for unlimited use and unrestricted exposure.

5.2.1.1 Deed Restriction and Reservation of Access

The federal deed(s) or letter(s) of transfer for any property within the IC boundaries will include a description of the residual contamination on the property, consistent with the AF's obligations under CERCLA Section 120(h), and the specific restrictions set forth in this section. The deed(s)

or letter(s) of transfer will include a legal description of the property to which the ICs apply and will contain provisions so that they run with the land (i.e., the restrictions will be binding on all subsequent purchasers of the land whether or not the deed to them contained the restrictions).

The AF and regulatory agencies may conduct inspections of the ICs and the affected property. The deeds or associated transaction documents will also contain a reservation of access to the property for the AF, EPA, and the State, and their respective officials, agents, employees, contractors, and subcontractors for purposes consistent with the AF Installation Restoration Program or the FFA. The AF will provide such access to regulatory agencies prior to transfer.
The environmental restrictions are the basis for part of the CERCLA 120(h)(3) covenant that the United States is required to include in the deed for any property that has had hazardous substances stored for 1 year or more or are known to have been released or disposed of on the property.

For any deed (non-federal entity) or letter of transfer (federal entity) transferring all or part of property within the LF004 IC compliance boundaries, ICs, in the form of land use restrictions, will be incorporated in the deed or letter of transfer as a grantee covenant, in substantially the following language:

- Grantee covenants and agrees that it will not use the LF004 capped area for residential purposes, hospitals for human care, public or private schools for persons under 18 years of age, or day-care centers for children.
- Grantee covenants and agrees that it will not install groundwater wells or extract groundwater from the property for any purpose other than remediation or monitoring.
- With respect to risks that may be posed via indoor air contaminated by chemicals volatilizing from shallow soil gas (vapor intrusion), the Grantee covenants either to: (a) design and construct structures intended for occupancy within the impacted areas identified in Figure 5-3, in a manner that would mitigate unacceptable risk under CERCLA and the NCP (e.g., through installation of a vapor intrusion barrier or gas collection system); or (b) evaluate the potential for unacceptable risk prior to the erection of any new occupied structure in the same area, and include mitigation of the vapor intrusion in the design/construction of the structure prior to occupancy if an unacceptable risk is posed under CERCLA and the NCP. The Grantee will coordinate any and all evaluation and potential mitigation measures with EPA Region 9 and ADEQ.
- Grantee covenants and agrees that it will not conduct or allow others to conduct activities that would cause disturbance of any equipment or systems associated with LF004 such as the permeable cap, interceptor trench and storm water drainage systems, LF004 fencing and signs, groundwater remediation and monitoring systems, and soil vapor remediation and monitoring systems.

The deed(s) transferring all or part of property within the LF004 IC compliance boundaries to a non-federal entity will also include a condition that the transferee execute and record a Declaration of Environmental Use Restriction (DEUR), within 10 days of transfer, to address any State obligations pursuant to State law, including the substantive portions of Arizona Revised

Statute (ARS) §49.152. Such deeds will include a condition that any future deeds include this requirement.

5.2.1.2 Notice of Institutional Control

The AF will include similar restriction language set forth in this ROD Amendment in the deed or letter of transfer for any portion of property within the LF004 IC compliance boundaries, and will provide a copy of the deed(s) or letter(s) of transfer containing the use restrictions to the regulatory agencies as soon as practicable after the transfer of fee title. The AF will inform the property owner(s) of the necessary ICs in the draft deed(s) or transfer documents. The signed deed(s) and/or transfer document(s) legally binding between the AF and transferee will also include the specific land use restrictions. Deeds for non-federal entities will include a condition that the transferee execute and record a DEUR, within 10 days of transfer, to address any State obligations pursuant to State law, including ARS §49.152. The AF will ensure that the transferee has met this condition. Any letter of transfer (to a federal entity) will include a condition that future deeds (non-federal entity) include this requirement. For any transfer, including to the Department of Interior and Bureau of Indian Affairs as trustee for the Gila River Indian Community, federal enforcement authority under CERCLA applies and the AF retains responsibility for the remedy, over which both the EPA and ADEQ have designated regulatory authorities. Concurrent with the transfer of fee title from the AF to the transferee, the Finding of Suitability for Transfer or the Finding of Suitability for Early Transfer, and the location of the administrative record file will be communicated in writing to the property owners and to appropriate state and local agencies (with a copy to EPA) with authority regarding any of the activities or entities addressed in the controls to ensure that such agencies can factor the information into their oversight, approval, and decision making activities regarding the property.

Prior to conveyance of any portion of property within the LF004 IC compliance boundaries, EPA and ADEQ representatives will be given reasonable opportunity to review and comment on the applicable deed language described in this section and associated rights of entry for purposes of institutional control oversight and enforcement.

The AF will provide notice to EPA and ADEQ at least six months prior to any transfer or sale of property. If it is not possible for the AF to notify EPA and ADEQ at least six months prior to any transfer or sale, then the AF will notify EPA and ADEQ as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to ICs. Additionally, the AF further agrees to provide EPA and ADEQ with similar notice, within the same timeframes, as to federal-to-federal transfers of property.

5.2.1.3 Annual Evaluations/Monitoring

Prior to property transfer, the AF will conduct annual monitoring, provide annual reports describing whether property use has conformed to ICs or use restrictions, and undertake prompt action to address activity that is inconsistent with the IC objectives or use restrictions, or any action that may interfere with the effectiveness of the ICs. The Air Force shall notify EPA and ADEQ 45 days in advance of any proposed land use changes that are inconsistent with land use control objectives or the selected remedy. The annual monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to

EPA and ADEQ. The annual monitoring reports will be used in preparation of the five-year review to evaluate the effectiveness of the remedy. Prior to transfer, the annual monitoring report submitted to the regulatory agencies by the AF will evaluate the status of the ICs and how any IC deficiencies or inconsistent uses have been addressed.

Following transfer of any or all of LF004, including all property within the LF004 IC compliance boundaries, the AF will be responsible to conduct OM&M of active remediation systems in accordance with the amended remedy, provide annual reports, and undertake prompt action to address activity that is inconsistent with the IC objectives or use restrictions, or any action that may interfere with the effectiveness of the ICs. While the AF retains discretion to and may arrange for the transferee or a contractor to undertake these responsibilities, the AF will retain primary and direct responsibility to ensure these OM&M obligations are fulfilled.

The AF will notify EPA and ADEQ as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the remedy. The AF will notify EPA and ADEQ regarding how the AF has addressed or will address the breach within 10 days of sending EPA and ADEQ notification of the breach. Any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the remedy will be addressed by the AF as soon as practicable, but in no case will the process be initiated later than 30 days after the AF becomes aware of the breach.

The Air Force will place the following two transferee obligations in the deed or other transfer documentation: (1) Upon the effective date of property conveyance, the transferee (or other entity accepting such obligations [which may include, without limitation, subsequent transferees] or subsequent property owner(s)) will conduct annual physical inspections of the property to confirm continued compliance with all institutional control objectives unless and until the institutional controls at the site are terminated; (2) The transferee or subsequent property owner(s) will provide to the Air Force, the EPA, and ADEQ, an annual monitoring report on the status of the institutional controls and how any institutional control deficiency or inconsistent uses have been addressed, whether use restrictions and controls were communicated in the deed(s) for any property transferred in the reporting period, and whether use of the property encompassing the area subject to institutional controls has conformed to such restrictions and controls.

If a transferee fails to provide an annual monitoring report as described above to the AF, the AF will notify EPA and ADEQ as soon as practicable. If EPA or ADEQ does not receive the annual monitoring report from the transferee, it will notify the AF as soon as practicable. Within 30 days of the report's due date, the AF will take steps to determine whether ICs are effective and remain in place and advise the regulators of its efforts. In any event, within 90 days of the report's due date, the AF will determine the status of ICs and provide its written findings, with supporting evidence sufficient to confirm the reported status, based on the use restrictions/ICs and site conditions, to EPA and ADEQ unless either EPA or ADEQ, in its sole discretion, acts to confirm the status of the ICs independently.

The five-year reviews conducted by the AF will also address whether the ICs in the ROD were inserted in the deed or letter of transfer, if property was transferred during the period covered; whether the owners and State and local agencies were notified of the ICs affecting the property; and whether use of the property has conformed to such ICs. Five-year reviews will make recommendations on the continuation, modification, or elimination of annual reports and IC monitoring frequencies. Five-year reviews are submitted by the AF to the regulatory agencies for review and comment.

Although the AF is transferring procedural responsibilities to the transferee and its successors by provisions to be included in the deed(s) or letter of transfer and may contractually arrange for third parties to perform any and all of the actions associated with the ICs, the AF is ultimately responsible for the remedy.

5.2.1.4 Response to Violations

Prior to property transfer, the AF will notify EPA and ADEQ as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs. The AF will notify EPA and ADEQ regarding how the AF has addressed or will address the breach within 10 days of sending EPA and ADEQ notification of the breach.

Following transfer of LF004 and as long as OM&M of active remediation systems is required, any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the remedy will be addressed by the AF as soon as practicable, but in no case will the process be initiated later than 30 days after the AF becomes aware of the breach.

The deed(s) or letter(s) of transfer will require that post-transfer, the transferee will notify the AF, EPA, and ADEQ of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs, and will address such activity or condition as soon as practicable, but in no case will the process be initiated later than 10 days after the transferee becomes aware of the breach. Post-transfer, if the transferee fails to satisfy its obligations pursuant to the DEUR, ADEQ may enforce such obligations against the transferee. If there is failure of the selected remedy or a violation of selected remedy obligations (e.g., an activity inconsistent with IC objectives or use restrictions, or any action that may interfere with the effectiveness of the ICs), ADEQ will notify the AF and EPA in writing of such failure as soon as practicable (but no longer than 14 days) upon discovery of the inconsistent activity or action that interferes with the effectiveness of the IC, and initially seek corrective action or other recourse from the transferee. If, after diligent efforts, ADEQ is unable to enforce the obligations of the DEUR or remedy obligations against the transferee, within 21 days following ADEQ's notification, the parties will confer to discuss re-implementation of the selected remedy or other necessary remedial actions to address the breach of the IC. Once ADEQ reports that the transferee is unwilling or unable to undertake the remedial actions, the AF will within 10 days inform the other parties of measures it will take to address the breach.

5.2.1.5 Approval of Land Use Control Modification

Prior to transfer, the AF will not modify or terminate ICs or implementation actions, or modify use restrictions that are part of the selected remedy without approval by EPA and ADEQ. The AF will seek prior concurrence before any anticipated action that may disrupt the effectiveness of the ICs or any action that may alter or negate the need for ICs.

Any grantee of property constrained by the ICs imposed through their transfer document(s) may request modification or termination of an IC. Modification or termination of an IC, except the DEUR (discussed below), requires AF, EPA, and ADEQ approval. Prior to seeking approval from the EPA and ADEQ, the recipient of the property must notify and obtain approval from the Air Force of any proposals for a land use change at a site inconsistent with the use restrictions and assumptions described in this ROD.

5.2.1.6 Declaration of Environmental Use Restriction Modification

Any modification or termination of the DEUR must be undertaken in accordance with Arizona law and will be the responsibility of the transferee or then-current owner or operator.

5.2.2 Compliance and In-Process Measurement

IWAS and SVE system sampling and groundwater monitoring will be conducted periodically during the operation of the treatment systems to evaluate the effectiveness of the selected remedy and determine when cleanup levels have been met. The details of this compliance and in-process measurement program will be specified in a LF004 Remedial Design/Remedial Action Work Plan. The LF004 Groundwater Monitoring Work Plan will be updated in coordination with EPA and ADEQ review and approval as needed throughout the remedial timeframe. The LF004 OM&M manual will describe methods to compare monitoring data over time to estimate progress of the treatment process.

5.2.3 Cost

The total present worth of Alternative 5 is between $8.2 million and $10.1 million. Appendix C presents a cost summary table and estimate for Alternative 5. The cost is an order-of-magnitude engineering estimate that is expected to be within +50 to -30 percent of the actual project cost. The information in the cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedy. Changes may be documented in the form of a memorandum in the Administrative Record file, an ESD, or a ROD amendment, as appropriate depending upon the nature of the cost change.

5.3 Expected Outcome

The expected outcome of the recommended alternative is that human health will be protected against exposure to contaminants, concentrations of residual contamination within shallow soil gas in unsaturated soil at the former AST area will be reduced to levels that are protective of

human health for unlimited use and unrestricted exposure, concentrations of residual contamination in soil gas and saturated soil and dissolved contaminants in groundwater near LF004 will be reduced to levels that will no longer result in contaminant concentrations in groundwater exceeding cleanup levels. The recommended alternative will achieve soil gas cleanup levels in approximately 2 years and groundwater cleanup levels in approximately 10 to 15 years, which will restore the aquifer to MCLs.

6.0 EVALUATION OF EXISTING AND AMENDED REMEDIES

This section provides an evaluation of the nine CERCLA criteria to compare Alternative B, the original selected remedy (described in Section 3.3 and the OU-1 ROD [AFBCA, 1994]), and Alternative 5, the amended selected remedy (described in Section 5.1 and the LF004 FFS [AMEC, 2013a]). Since the OU-1 ROD did not identify a soil gas or groundwater remedy, the existing remedy will be considered a “no action” remedy in comparison to the amended remedy for PCE and TCE in soil gas and groundwater.

6.1 Overall Protection of Human Health and the Environment

Alternative 5 will provide protection to human health and the environment through removal of soil vapor and groundwater contaminants to meet the RAOs. Until RAOs are achieved, ICs would provide protection.

Alternative B, the original selected remedy, would not provide protection to human health and the environment. This alternative would result in unacceptable risks to future human receptors exposed to groundwater and soil gas as identified in the screening-level human health risk assessment.

6.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 5 will be designed and implemented to meet ARARs (see Appendix B).

Alternative B, the original selected remedy, would not comply with ARARs. Specifically, the chemical-specific standards for groundwater and risk-based RAO for soil gas would not be met.

6.3 Long-Term Effectiveness and Permanence

Alternatives 5 is an effective and permanent solution, using ICs to prevent human exposures to residual risk until cleanup levels are achieved and a combination of active treatment and natural attenuation to reduce contaminants to cleanup levels. Residual risk from Alternative 5 is related to the time to achieve cleanup, which would be shortened by treatment of groundwater contamination and removal of soil gas contamination. Groundwater concentrations may meet cleanup levels approximately 10 to 15 years after starting to operate the IWAS wells. Soil gas concentrations may meet cleanup levels approximately two years after starting to operate the SVE system. Groundwater monitoring in association with post-closure care for the landfill will continue after completion of the groundwater remedy. Periodic evaluation of the amended remedy will be addressed in Five-Year Reviews.

Alternative B, the original selected remedy, does not reduce the contamination in either groundwater or soil gas or prevent migration of contamination within the media and, therefore, does not reduce the magnitude of residual risk.

6.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5 satisfies the CERCLA preference for reduction of toxicity, mobility, or volume through treatment. Alternative 5 will satisfy this preference through direct removal of dissolved contamination via air stripping and vapor treatment. The oxidation components of the alternative would result in direct chemical destruction of contamination and also provide a permanent reduction in toxicity, mobility, and volume. The SVE portion of Alternative 5 will achieve a reduction in volume using treatment methods that concentrate contaminants on treatment media (e.g., on activated carbon). A further reduction in volume, and a reduction in mobility and toxicity, will be achieved if the activated carbon is incinerated or thermally regenerated with thermal destruction of the contaminants.

Alternative B, the original selected remedy, would not reduce the toxicity, mobility, and volume of contamination through treatment since no treatment would be performed.

6.5 Short-Term Effectiveness

Alternative 5 uses ICs and safety procedures to protect the community, workers, and the environment from short-term risks. Contaminated groundwater is treated at depth, and there are no residences or places of business in the areas where remedial construction and/or extraction of contaminants is planned. Alternative 5 involves the handling of investigation-derived waste (IDW) that contains hazardous constituents and installation of groundwater remediation and vapor extraction wells along with associated piping and equipment. None of these activities are unusually hazardous provided normal safeguards are used for the safety of site workers and to prevent releases to the environment from remedial action activities. The period of active operation of the remediation systems is estimated at approximately 10 years for IWAS and less for IWAS in combination with oxidation, although shorter or longer remediation timeframes could result from different design configurations or rates of remedial effectiveness.

There are no current exposures that exist at LF004 under Alternative B, the original selected remedy, and the existing remedy poses no risks to workers or the community because no actions would be taken. However, there are no ICs in place that would prevent potential exposure to contaminants in soil gas and groundwater. Without active treatment the timeframe until cleanup levels are achieved under Alternative B would be in the hundreds of years.

6.6 Implementability

The equipment and materials needed to implement Alternative 5 are readily available from commercial vendors and the groundwater treatment and SVE technologies are well established and conventional. Site conditions at LF004 are appropriate for application of the technologies and the technologies are adaptable to varying conditions, so the reliability of the technologies to achieve cleanup levels is high.

Alternative B, the original selected remedy, is logistically and technically implementable because no action would be performed.

6.7 Cost

Costs associated with Alternative 5 relate to remedial design; IWAS, SVE, and oxidation system installations; OM&M of the systems; groundwater monitoring; and reporting; and five-year reviews. The initial capital cost for Alternative 5 is estimated to be between $5.4 million and $5.7 million, with the higher end of the range associated with the use of oxidant injection wells. The present value cost for 10 years of OM&M including groundwater monitoring and five-year reviews is between $2.5 million and $4.7 million with the lower end of the range associated with a shorter duration and the use of oxidant. A more detailed cost summary for Alternative 5 is presented in Appendix C. The total present worth of Alternative 5 is between $8.2 million and $10.1 million.

Alternative B, the original selected remedy, was initially estimated as costing $3.32 million dollars. A current estimate of costs to continue complying with the OU-1 ROD requirements is $2.1 million dollars assuming that groundwater monitoring would continue beyond the original 30 years required in the ROD in order to monitor contaminants that continue to exceed the cleanup levels (AMEC, 2013a).

6.8 Support Agency Acceptance

EPA Region IX and ADEQ have been involved in the technical review of the FFS and the development of the Amended Proposed Plan and ROD Amendment. The EPA and the ADEQ supported Alternative 5 as the preferred alternative presented in the Amended Proposed Plan. Regulatory agency comments on the ROD Amendment and Air Force responses to agency comments are provided in Appendix D.

Discussions with regulatory agencies after the discovery of PCE and TCE concentrations above MCLs resulted in agreement between the agencies and the AF that Alternative B was no longer protective of human health and the environment in the long term and not in compliance with ARARs. Consequently, Alternative B is no longer supported by the regulatory agencies as a long-term solution for soil gas and groundwater at LF004.

6.9 Community Acceptance

Mailings, a public notice, a public comment period and a public meeting occurred in May 2013 (see Section 9.0) to solicit input on the preferred alternate, Alternative 5 from the FFS. No oral or written public comments, in favor or against the preferred alternative, were received during the public meeting or comment period. Therefore, the community acceptance of the amended remedy is inferred.

Feedback received on Alternative B, the original selected remedy, during the public comment period and the AF's responses can be found in the responsiveness summary of the OU-1 ROD (AFBCA, 1994).

7.0 SUPPORT AGENCY COMMENTS

Regulatory agency comments on the ROD Amendment and Air Force responses to agency comments are provided in Appendix D.

8.0 STATUTORY DETERMINATIONS

Under section 121 of CERCLA, and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements for LF004.

8.1 Protection of Human Health and the Environment

The amended Selected Remedy is protective of human health and the environment because ICs will prevent exposure to contaminated groundwater and soil gas until the RAOs are met. Shallow soil gas contamination is the former AST area will be extracted to the screening levels identified in Appendix B at which time residual site-specific risk from soil gas will be reevaluated with anticipated results of an ILCR within or below the risk management range of 10^{-6} to 10^{-4}. The site specific risk assessment will also evaluate the other three areas of shallow soil gas contamination with an anticipated result of an ILCR within or below the risk management range of 10^{-6} to 10^{-4}. Deep soil gas contamination associated with groundwater and dissolved phase contamination and groundwater will be extracted or treated to the ARAR cleanup levels identified in Appendix B. Achievement of these cleanup levels is anticipated to result in an ILCR within or below the risk management range of 10^{-6} to 10^{-4} and an HI of less than 1. There is no current exposure to contaminants and ICs will control future exposure until demonstration that RAOs/cleanup levels are achieved. Soil gas confirmation sampling and groundwater compliance monitoring will evaluate the progress of the remedy. Five-year reviews will ensure the Selected Remedy is and will continue to be protective of human health and the environment.

The landfill cap will remain in accordance with OU-1 ROD (AFBCA, 1994), eliminating the primary exposure pathway for soil. The only remaining pathway for exposure to contaminated soil is through cuttings generated during well installation. This exposure pathway can also be eliminated by proper work and waste disposal practices.

8.2 Compliance with Applicable or Relevant and Appropriate Requirements

The amended Selected Remedy will comply with chemical-, location-, and action-specific ARARs, which are presented in more detail in Appendix B.

8.2.1 Chemical-Specific ARARs

Chemical-specific ARARs are presented in Table B-1 of Appendix B. Groundwater cleanup levels are presented in Table B-2, and groundwater and soil gas screening levels are presented in Tables B-3 and B-4 respectively. Cleanup levels are based on federal MCLs. Screening levels are based on federal MCLs, Arizona AWQSs if more stringent than MCLs or there is no MCL, and to be considered criteria. The risk-based EPA RSLs are to be considered criteria for groundwater and soil gas contaminants that do not have ARARs.

The amended Selected Remedy will comply with chemical-specific ARARs through groundwater treatment and soil gas extraction and treatment.

8.2.2 Location-Specific ARARs

Location-specific ARARs are presented in Table B-1 of Appendix B. Location-specific ARARs will be addressed by complying with the Programmatic Agreement for Base Realignment and Closure Act (AF, 1995) at Williams AFB, as needed, to avoid irreparable harm, loss or destruction of discovered significant artifacts and to preserve or provide respectful disposition of Native American human remains.

8.2.3 Action-Specific ARARs

Action-specific ARARs are presented in Table B-1 of Appendix B. Action-specific ARARs will be complied with during installation of wells and other activities generating IDW (e.g., groundwater sampling) through proper management and characterization of IDW. Dust control measures will be implemented during well construction. Air and water discharges will comply with applicable emission discharge limits.

8.3 Cost Effectiveness

The present worth cost of the soil gas and groundwater components of the amended Selected Remedy are estimated to be between $8.2 million and $10.1 million. The lower end of the range assumes a shorter treatment duration with the addition of an oxidant compared to the higher end of the range, which assumes IWAS wells only. The amended Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness” (NCP §300.430(f)(1)(ii)(D)). The original LF004 remedy no longer satisfies the threshold criteria of Protection of Human Health and the Environment or Compliance with ARARs for soil gas and groundwater, thereby making the amended Selected Remedy the more cost-effective alternative since it does satisfy the threshold criteria.

8.4 Utilization of Permanent Solution and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Possible

The amended Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practical manner at the site. It is considered to provide the best balance of trade-offs with respect to the balancing criteria set out in the NCP (40 CFR 300.430(f)(1)(i)(B)), i.e., (1) long-term effectiveness and permanence, (2) reduction of toxicity, mobility, or volume through treatment, (3) short-term effectiveness, (4) implementability, and (5) cost.

8.5 Preference for Treatment as a Principal Element

The amended Selected Remedy satisfies the statutory preference for treatment as a principal element of the remedy by incorporating extraction and treatment of contamination from soil gas

and groundwater. The Selected Remedy satisfies the regulatory requirements set forth in Section 121 of CERCLA.

8.6 Five Year Reviews

Because the existing and amended OU-1 remedy results upon completion in hazardous substances, pollutants, or contaminants remaining on-site above levels allowing for unlimited use and unrestricted exposure, a statutory review will continue to be required at five-year intervals to ensure that the remedy is, or will be, protective of human health and the environment.

9.0 PUBLIC PARTICIPATION COMPLIANCE

The Amended Proposed Plan and the associated Administrative Record file for LF004 soil gas and groundwater at the former Williams AFB, in Mesa, Arizona, was made available to the public in April 2013. The notice of the availability was published in the East Valley Tribune and Mesa Independent on 29 April 2013. A public comment period was held from 1 May 2013, to 30 May 2013. In addition, a public meeting was held on 14 May 2013 on the former Williams AFB to present the Amended Proposed Plan. At this meeting, the AF answered clarifying questions about the site and the remedial alternatives. The AF also used this meeting to solicit a cross-section of community input on the OU-1 LF004 soil gas and groundwater preferred alternative. No comments were received at the public meeting or during the public comment period so no transcript or responsiveness summary was necessary.

Upon completion of authorizing signatures for the OU-1 ROD Amendment, a notice of the amendment's availability will be published in the East Valley Tribune and Mesa Independent newspapers. An administrative record that contains the documents relating to investigation and cleanup activities performed at or proposed for former Williams AFB is available for public inspection online. The completed OU-1 ROD Amendment will be available in the administrative record prior to commencement of the soil gas and groundwater remedial action. The administrative record can be accessed by the public at all hours at the following URL: https://afrpaar.lackland.af.mil/ar/. Documents comprising the Administrative Record can also be accessed at the former McClellan AFB, located at 3411 Olson Street, McClellan, CA 95652. In addition, an information repository is available in the Government Documents Section at the ASU Library, 300 East Orange Mall, Tempe, Arizona, 85287.

The activities described above meet the public participation requirements in CERCLA §§113(k) and 117(c) (42 U.S. Code §§ 9613(k) and 9617(c)) and the NCP (40 CFR § 300.435(c)(2)(ii)) during the remedy selection process.

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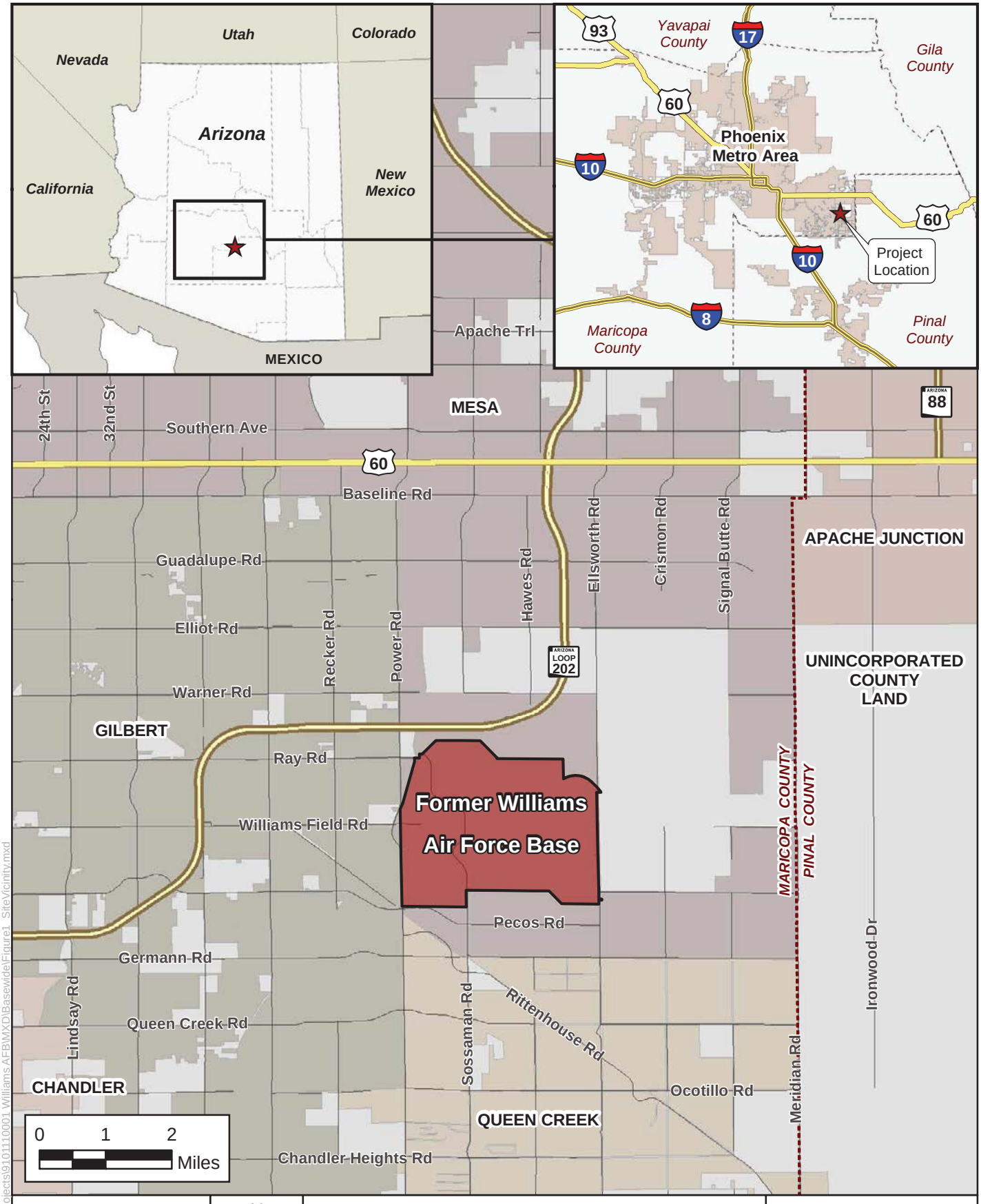
FIGURES



Job No.	9101110001
PM:	EW
Date:	04/15/2013
Scale:	1" = 2 miles

N

Former Williams Air Force Base
Mesa, Arizona

Location of Former Williams Air Force Base

FIGURE **1-1**

Path: X:\Projects\2012 Projects\9101110001 Williams AFB\MXD\LF004\Site Location Maps\Figure1-2_LF004_Site_Location_Map_AFCEC_LQGO.mxd

Job No.	9101110001
PM:	EW
Date:	1/22/2014
Scale:	1" = 0.5 mile

Former Williams Air Force Base
Mesa, Arizona

LF004 Site Location Map

FIGURE
1-2

ASU Bee Lab Annex

Chandler-Gilbert Maricopa County Community College Mock Utility Pole Area

Old Pecos Road

City of Mesa Sewer Lift Station

Former Wastewater Treatment Plant

Former AST

S Power Road

E Pecos Road

Pittenhouse Channel

LF01-LA05
LF01-LA04
LF01-LA03B
LF01-LA03(D)
LF01-LA06
LF01-LA05B
LF01-LA02
LF01-LA01

LF01-W01
LF01-W02
LF01-W03
LF01-W04
LF01-W05
LF01-W06
LF01-W07
LF01-W08
LF01-W09S
LF01-W09A
LF01-W10
LF01-W11
LF01-W11R
LF01-W12
LF01-W13
LF01-W14
LF01-W15
LF01-W16
LF01-W17
LF01-W18
LF01-W19
LF01-W20
LF01-W21
LF01-W28

Legend

- Existing Building/Structure
- Razed Building/Structure
- Former Williams AFB Boundary
- LF004 Boundary
- Fence Line
- Water Line
- Natural Gas Line
- Sanitary Sewer Line
- Overhead Electric Line
- Underground Electric Line
- Product Line
- Underground Power Line (Kinder Morgan Private Electric, HighVoltage - 480)
- Surface Water Drainage Ditch
- Southwest Drainage System
- Former Sewage Sludge Trenches
- Monitoring Well Location and ID
- Decommissioned Monitoring Well Location and ID

0 150 300 Feet

N

Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

Site Map

FIGURE 3-1

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1"=300 Feet

BH1100		
Depth	TCE	PCE
Soil		
8.5-10	ND	ND
29.25-30	ND	ND
48.5-50	ND	ND
68.5-70	ND	ND
88.5-91	ND	ND
108.5-110	ND	ND
128.5-130	ND	ND
Soil Gas		
125	0.21	1.8

BH1101		
Depth	TCE	PCE
Soil		
4-5	ND	ND
29-30	ND	ND
49.5-50	ND	ND
68.5-70	ND	ND
88.5-90	ND	ND
108.5-110	0.8 FML	2.2 FML
128.5-130	ND	2.0 FML
Soil Gas		
125	1.3	5.0

BH1102		
Depth	TCE	PCE
Soil		
8.5-10	ND	ND
29-30	ND	ND
49-50	ND	ND
69-70	ND	ND
89-90	1.5 F	2.2 F
108.5-110	ND	ND
128.5-130	ND	ND
Soil Gas		
125	6.5	7.5

BH1206		
Depth	TCE	PCE
Soil Gas		
20	14 S	6.5 S
40	7.5 S	2.7 S
60	0.26 FS	ND
80	0.71 FS	0.29 FS
100	8.0 S	3.9 S
120	16 S	10 S
140	8.7 S	1.1 S

BH1202		
Depth	TCE	PCE
Soil Gas		
20	19 S	1.8 S
40	32 S	2.9 S
60	34 S	2.5 S
80	41 S	3 S
100	21 S	1.3 S
120	6.5 S	0.64 FS
140	3.1 S	0.26 FS

BH1204		
Depth	TCE	PCE
Soil Gas		
20	16 S	1.6 S
40	8.5 S	0.68 FS
60	34 S	3.6 S
80	58 S	6.8 S
100	16 S	1.5 S
120	ND	ND
140	40 S	3.6 S

BH1210		
Depth	TCE	PCE
Soil Gas		
20	0.65 FS	ND
40	4.8 S	0.73 FS
60	1.7 S	ND
80	3.4 S	0.58 FS
100	5.3 S	1.0 S
120	3.9 S	1.3 S
140	5.8 S	1.4 S

BH1212		
Depth	TCE	PCE
Soil Gas		
20	3.0 S	0.29 FS
40	0.56 FS	ND
60	2.7 S	0.24 FS
80	0.95 FS	ND
100	7.8 S	0.77 FS
120	4.7 S	0.76 FS
140	6.7 S	0.83 FS

BH1203		
Depth	TCE	PCE
Soil Gas		
20	0.25 FS	ND
40	4.2 S	0.42 FS
60	0.97 FS	ND
80	5.1 S	0.42 FS
100	0.9 FS	ND
120	0.79 FS	ND
140	0.78 FS	ND

BH1201		
Depth	TCE	PCE
Soil Gas		
20	1.6 S	ND
40	11 S	0.79 FS
60	34 S	2.5 S
80	63 S	4.3 S
100	18 S	1 S
120	42 S	3.2 S
140	0.32 FS	ND

BH1211		
Depth	TCE	PCE
Soil Gas		
20	1.2 S	ND
40	3.2 S	ND
60	5.0 S	0.23 FS
80	34 S	1.1 S
100	82 S	2.8 S
120	60 S	2.7 S
140	84 S	3.4 S

BH1208		
Depth	TCE	PCE
Soil Gas		
20	6.2 S	0.33 FS
40	2.0 S	ND
60	0.66 FS	ND
100	11 S	0.26 FS
120	18 S	0.49 FS
140	60 S	5.8 S

BH1213		
Depth	TCE	PCE
Soil Gas		
20	1.1 S	ND
40	8 S	0.37 FS
60	16 S	0.85 FS
80	25 S	0.84 FS
100	31 S	0.66 FS
120	15 S	0.43 FS
140	22 S	2.1 S

BH1205		
Depth	TCE	PCE
Soil Gas		
20	ND	ND
60	0.36 FS	ND
80	0.36 FS	ND
100	2.7 S	ND
120	18 S	0.71 FS
140	10 S	1.2 S

BH1214		
Depth	TCE	PCE
Soil Gas		
20	1.3 S	ND
40	7 S	0.62 FS
60	13 S	1.0 S
80	6.2 S	0.31FS
100	4.2 S	ND
120	89 S	2.0 S
140	36 S	4.6 S

BH1408		
Depth	TCE	PCE
Soil		
13.5-15	ND	ND
29-30	ND	ND
54.5-55	ND	ND
66.5-70	ND	ND
89.5-90	ND	ND
113.75-115	ND	ND
134-135	ND	ND
Soil Gas		
135	4.1	3.8

BH1209		
Depth	TCE	PCE
Soil Gas		
20	6.3 S	1.7 S
40	5.8 S	1.2 S
60	5.1 S	0.92 FS
80	9.0 S	2.0 S
100	2.8 S	0.78 FS
120	13 S	4.4 S
140	0.86 FS	0.24 FS

BH1200		
Depth	TCE	PCE
Soil Gas		
20	12 S	0.97 FS
40	9.2 S	0.60 FS
60	16 S	1.1 S
80	34 S	2.8 S
100	30 S	2.4 S
120	18 S	2.6 S
140	33 S	9.4 S

BH1207		
Depth	TCE	PCE
Soil Gas		
20	ND	ND
40	0.71 FS	ND
60	ND	ND
80	0.23 FS	ND
100	26 S	1.3 S
120	78 S	5.8 S
140	39 S	9 S

BH1401		
Depth	TCE	PCE
Soil		
9-10	ND	ND
39.5-40	ND	ND
44-45	ND	ND
79.5-80	ND	ND
99-100	ND	ND
118.5-120	3 FML	14 ML
139-140	ND	ND
148.5-150	ND	ND
Soil Gas		
20	1.200	1.700
40	0.490	0.910
60	0.940	2.700
80	ND	ND
100	0.140	0.700
120	0.850	3.000
140	0.026	0.095

BH1402		
Depth	TCE	PCE
Soil		
4.5-5	ND	ND
28.5-30	ND	ND
49-50	ND	ND
73.5-75	ND	ND
88.5-90	ND	ND
104.5-105	0.85 F	4.3 F
129.5-130	ND	ND
154.5-155	ND	0.96 F
Soil Gas		
140	5.8	31

BH1406		
Depth	TCE	PCE
Soil Gas		
20	0.19	1.2
40	0.45	0.84
60	0.43	0.80
80	0.26	0.96
100	0.17	0.72
120	0.56	2.30
140	0.56	1.90

BH1403		
Depth	TCE	PCE
Soil		
9.5-10	ND	ND
29.5-30	ND	ND
48.5-50	ND	ND
74.5-75	ND	ND
84-85	ND	ND
99-100	ND	ND
114-115	ND	ND
144-145	ND	ND
Soil Gas		
135	4.4	4.7

BH1404		
Depth	TCE	PCE
Soil		
4.5-5	ND	ND
29-30	ND	ND
49-50	ND	ND
64.5-65	ND	ND
89.5-90	ND	ND
108.5-110	ND	ND
128.5-130	ND	1.8 F
148.5-150	ND	1.3 F
Soil Gas		
130	1.4	3.9

Former IRP Decontamination Area

Former AST

OU-1 No Further Action
IRP Site DP013
(Pesticide Burial Area)

Cleared Area Visible in
1964 Aerial Photograph

Legend

- Shallow Soil Gas Location (with no detections)
- Shallow Gas Location (with detections shown in red) (mg/m^3)
- Deep Soil Boring Location
- Monitoring Well Location
- Decommissioned Monitoring Well Location
- Former Williams AFB Boundary
- LF004 Site Boundary
- Fence Line
- Estimated Extent of TCE Contamination in Shallow Soil Gas (1-10 mg/m^3) (dashed where inferred)
- Estimated Extent of TCE Contamination in Shallow Soil Gas (>10 mg/m^3)
- Estimated Extent of PCE Contamination in Shallow Soil Gas (1-10 mg/m^3) (dashed where inferred)
- PH1330 (7) — Location ID and Associated Sample Depth (ft bgs)
- ND — Non Detect
- NS — Not Sampled
- Estimated result.
- F — Associated concentration is above MDL and below RL.
- ML — A matrix effect was present. The result is biased low.
- S — Screening level data.

Notes:
1. All utility locations are approximate only.
2. All soil results shown in µg/kg.
3. All soil gas results shown in mg/m³.

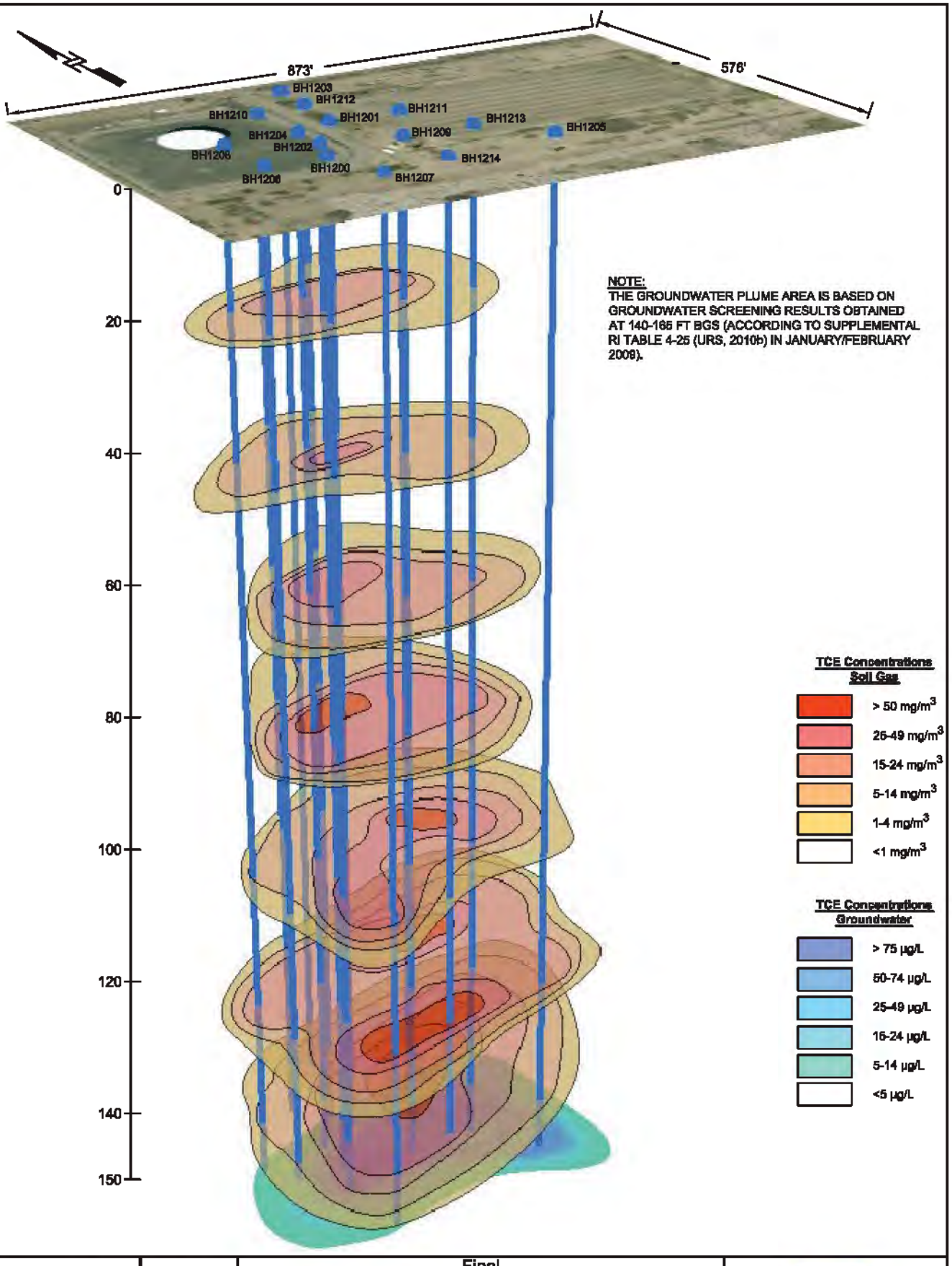
0 130 260 Feet

N

Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

Supplemental RI Soil and Soil Gas Sampling Results — FIGURE 3-2

Job No. 9101110001
PM: EW
Date: 01/10/2014
Scale: 1"=260 Feet



Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	NTS

N

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Former Williams Air Force Base
Mesa, Arizona

Supplemental RI TCE Soil Gas And Groundwater Screening Sampling Results

FIGURE 3-3

BH1100
TCE=ND
PCE=0.41 F
(145 ft bgs)

BH1101
TCE=ND
PCE=ND
(140 ft bgs)

BH1102
TCE=0.41F
PCE=0.7F
(140 ft bgs)

BH1210
TCE=2.3
PCE=7.66
(150 ft bgs)

BH1204
TCE=6.71
PCE=9.67
(150 ft bgs)

BH1208
TCE=6.44
PCE=7.87
(150 ft bgs)

BH1202
TCE=89
PCE=13.9
(150 ft bgs)

BH1206
TCE=17.9
PCE=14.7
(150 ft bgs)

BH1400
TCE=12
PCE=9
(145 ft bgs)

BH1200
TCE=75.4
PCE=18.3
(150 ft bgs)

BH1207
TCE=7.84
PCE=3.82
(150 ft bgs)

BH1401
TCE=1.3
PCE=7.6
(155 ft bgs)

BH1402
TCE=4.1
PCE=28
(165 ft bgs)

BH1403
TCE=4.4
PCE=10
(155 ft bgs)

BH1404
TCE=6.9
PCE=40
(150 ft bgs)

BH1203
TCE=0.662F
PCE=4.01
(150 ft bgs)

BH1201
TCE=21.7
PCE=10.6
(150 ft bgs)

BH1211
TCE=55.6
PCE=9.22
(150 ft bgs)

BH1205
TCE=50.1
PCE=3.33
(150 ft bgs)

BH1213
TCE=25.8
PCE=16.7
(150 ft bgs)

BH1209
TCE=75.3
PCE=20.2
(150 ft bgs)

BH1500
TCE=ND
PCE=ND
(165 ft bgs)

BH1501
TCE=0.24 F
PCE=0.79 F
(168.5 ft bgs)

BH1502
TCE=ND
PCE=ND
(173.5 ft bgs)

LF01-LA05
LF01-LA04
LF01-LA03(D)
LF01-LA03S
LF01-LA06S
LF01-LA06
LF01-LA01
LF01-LA02
LF01-W12
LF01-W13
LF01-W14
LF01-W15
LF01-W07
LF01-W08
LF01-W16
LF01-W21
LF01-W10
LF01-W10S
LF01-W09S
LF01-W09A
LF01-W28
LF01-W19
LF01-W20
LF01-W17
LF01-W11R
LF01-W11
LF01-W24

Old Pecos Road
S Power Road
E Pecos Road
Former AST

Legend

- Existing Building/Structure
- Razed Building/Structure
- Former Williams AFB Boundary
- LF004 Boundary
- Southwest Drainage System
- Former Sewage Sludge Trenches
- Surface Water Drainage Ditch
- Decommissioned Monitoring Well Location
- Monitoring Well Location
- Groundwater Screening Sample Location
- ND — Not Detected
- NS — Not Sampled
- F — Estimated result. Associated concentration is above MCL and below RL.
- MH — Matrix effect. Result biased high.
- ft bgs — Feet Below Ground Surface

Notes:

1. Approximate sample depth for result shown in parenthesis.
2. Concentrations presented in µg/L.
3. Concentrations shown in **BLUE** are below MCL/AWQS (5 µg/L).
4. Concentrations shown in **RED** are above MCL/AWQS (5 µg/L).
5. Samples collected in 2007 and 2009.

0 175 350
Feet

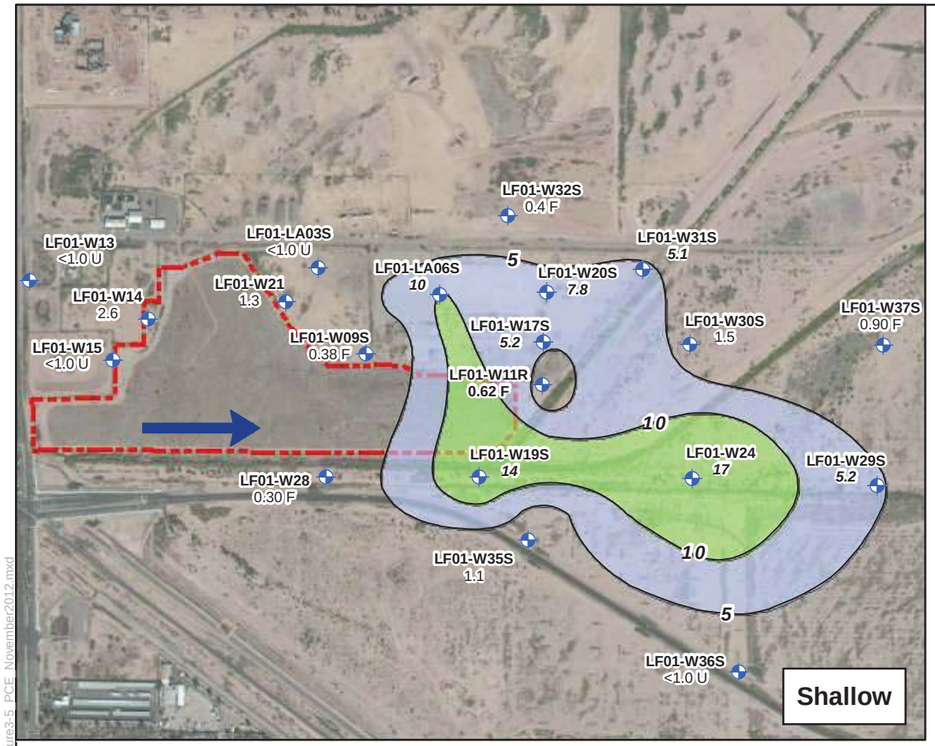
N

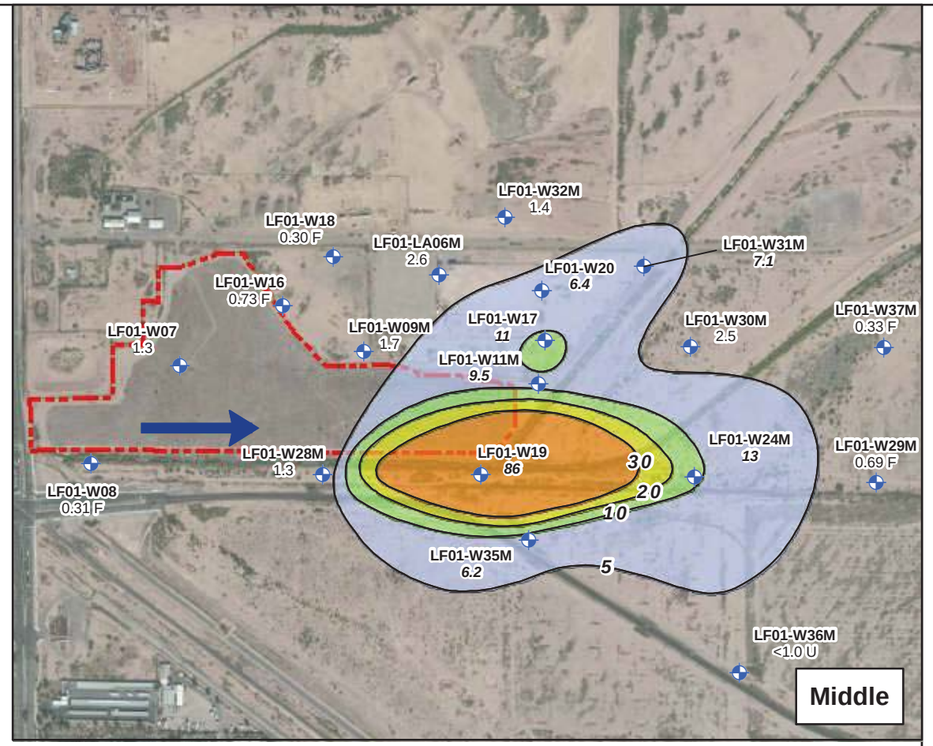
Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

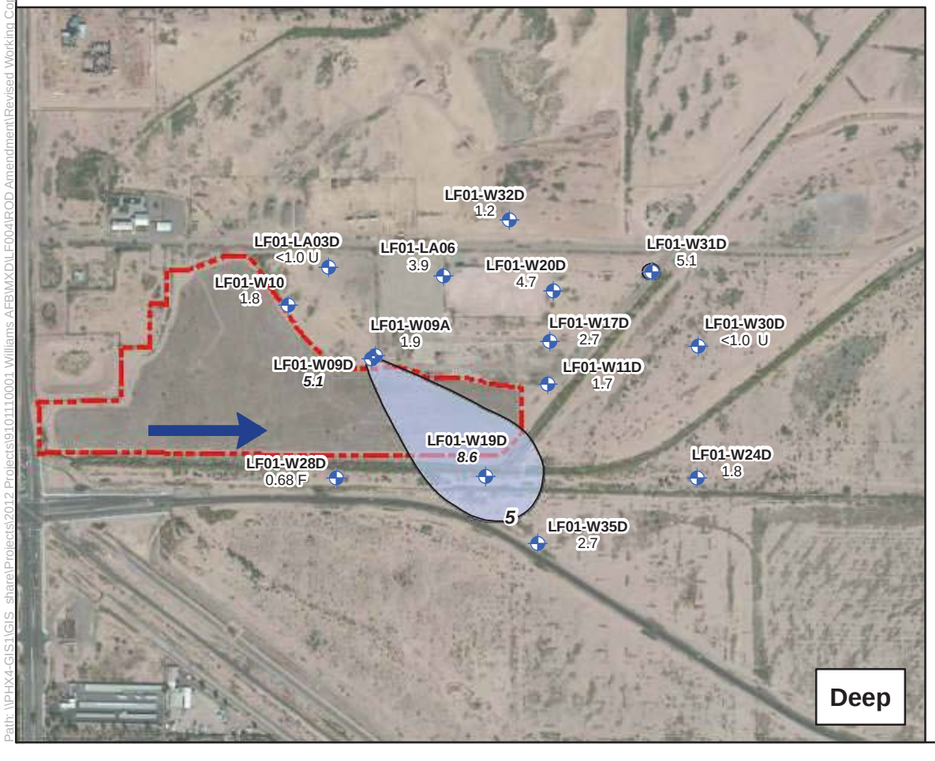
Supplemental RI
Groundwater Screening Results

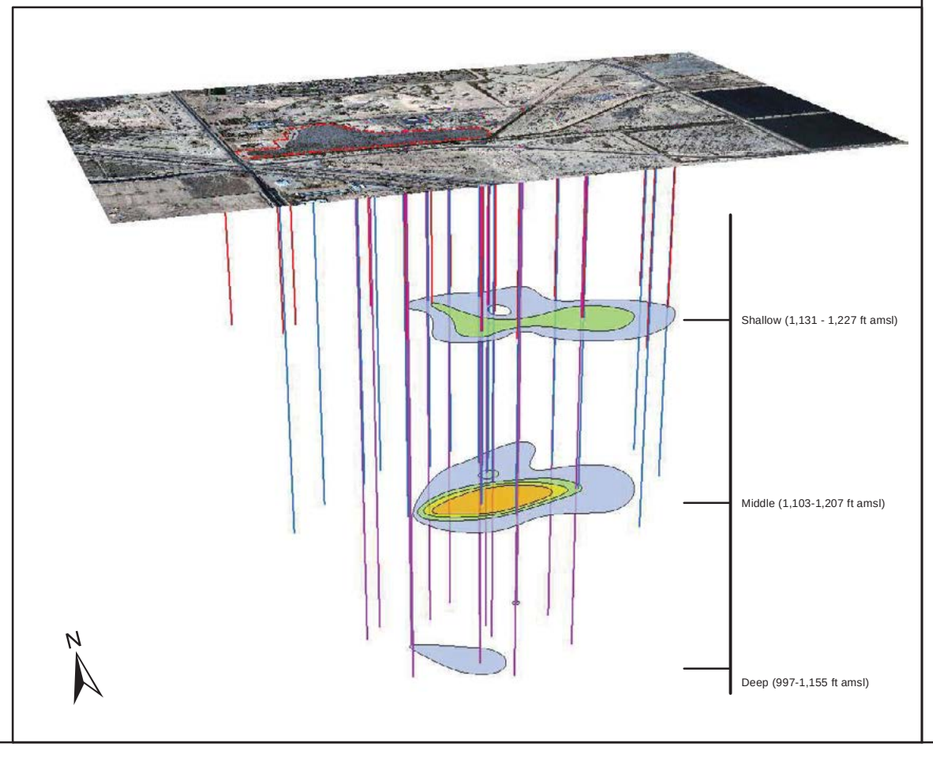
FIGURE 3-4

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1"=350 Feet









Legend

PCE Concentrations (µg/L) in Groundwater

- *5-10 µg/L
- 10-20 µg/L
- 20-30 µg/L
- ≥30 µg/L

** AWQS/MCL = 5 µg/L*

- Groundwater Flow Direction
- Monitoring Well Location
- LF004 Boundary

Notes:

LF04-W11M *9.5*	Monitoring Well Identification Maximum PCE Concentration (µg/L) (Results that are ***italicized and bolded*** equal or exceed the AWQS MCL of 5 µg/L)
µg/L	Microgram per liter
<1	Not detected at or above the RL
AWQS	Arizona Aquifer Water Quality Standards
F	The analyte was positively identified but the associated concentration is an estimation above the MDL and below the RL
ft amsl	Feet above mean sea level
MCL	Environmental Protection Agency Maximum Contaminant Levels
MDL	Method Detection Limit
RL	Reporting Limit
PCE	Perchloroethene
U	The analyte was analyzed for, but not detected at or above the RL shown

0 200 400 800 Feet

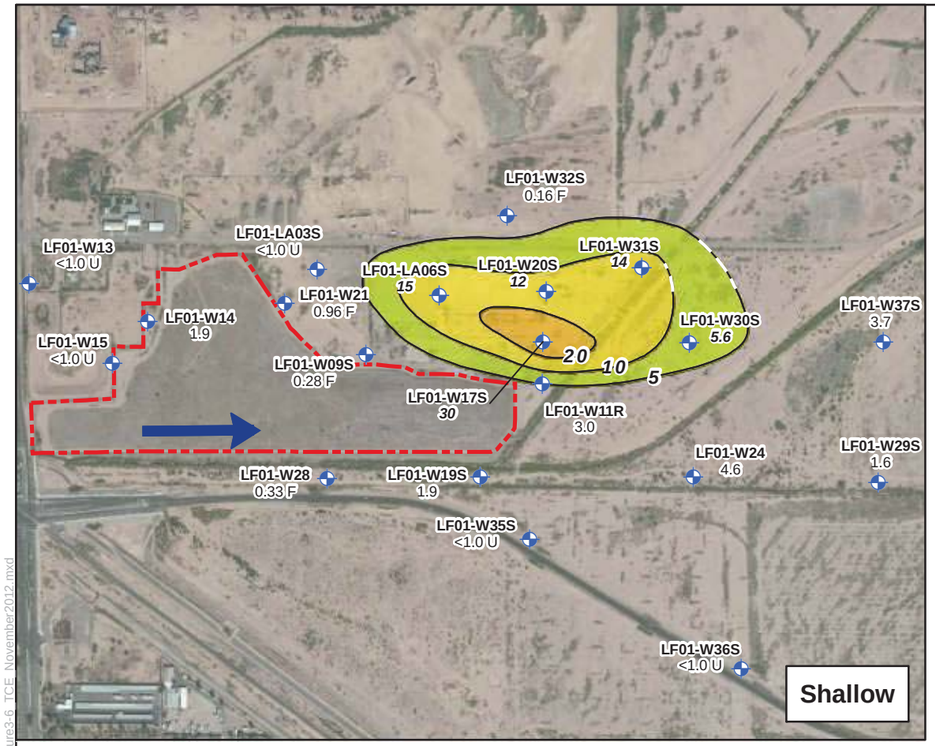
N

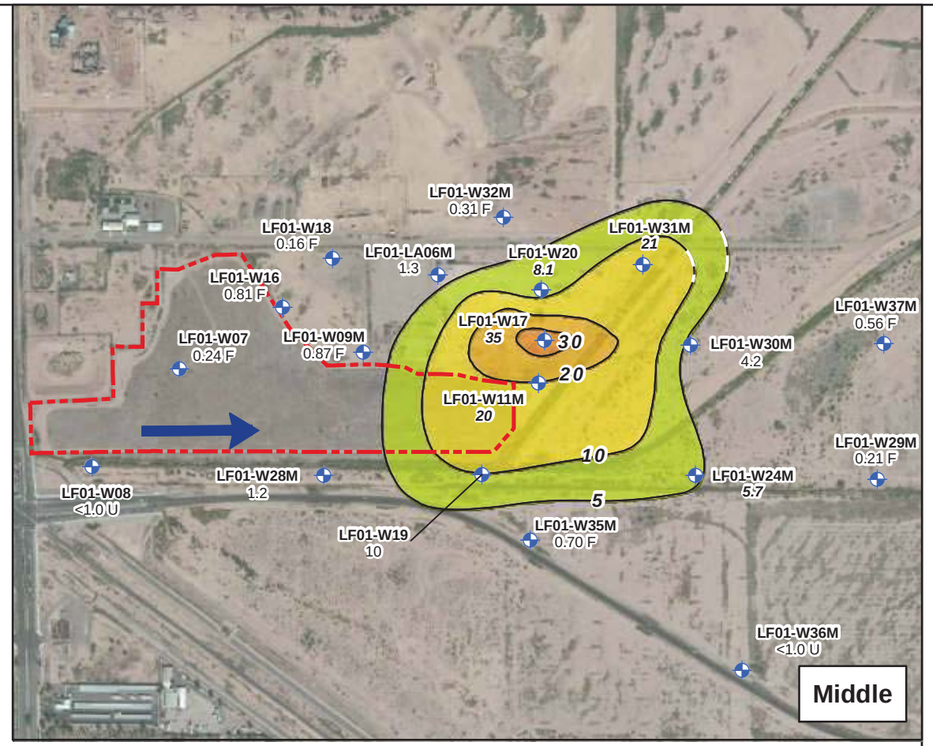
Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

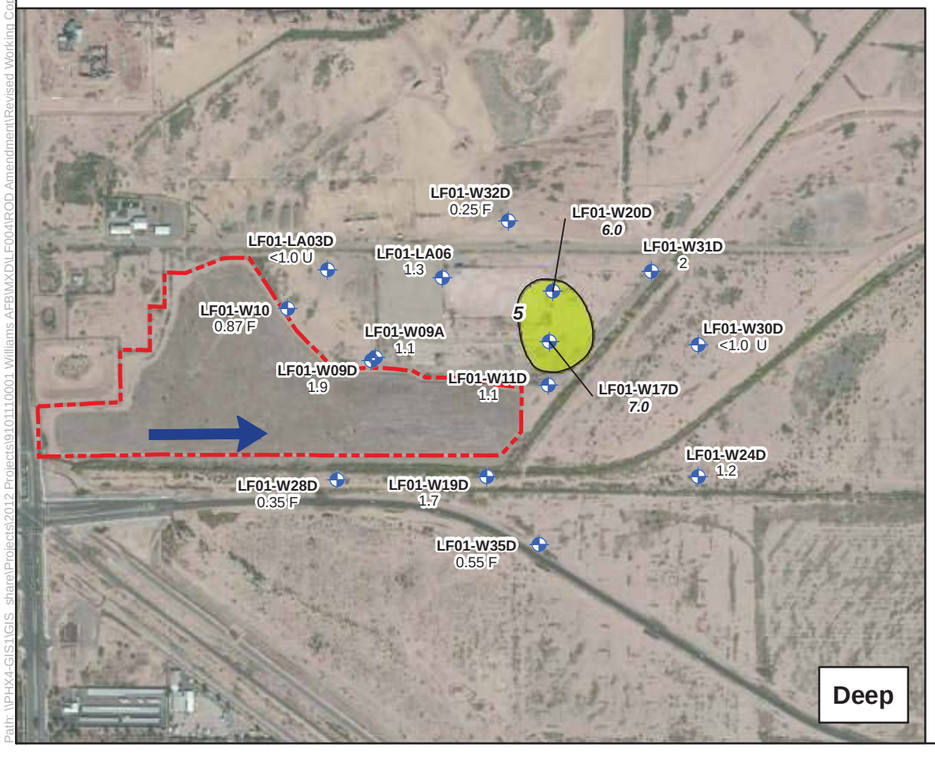
November 2012
PCE Concentrations in Groundwater by Depth

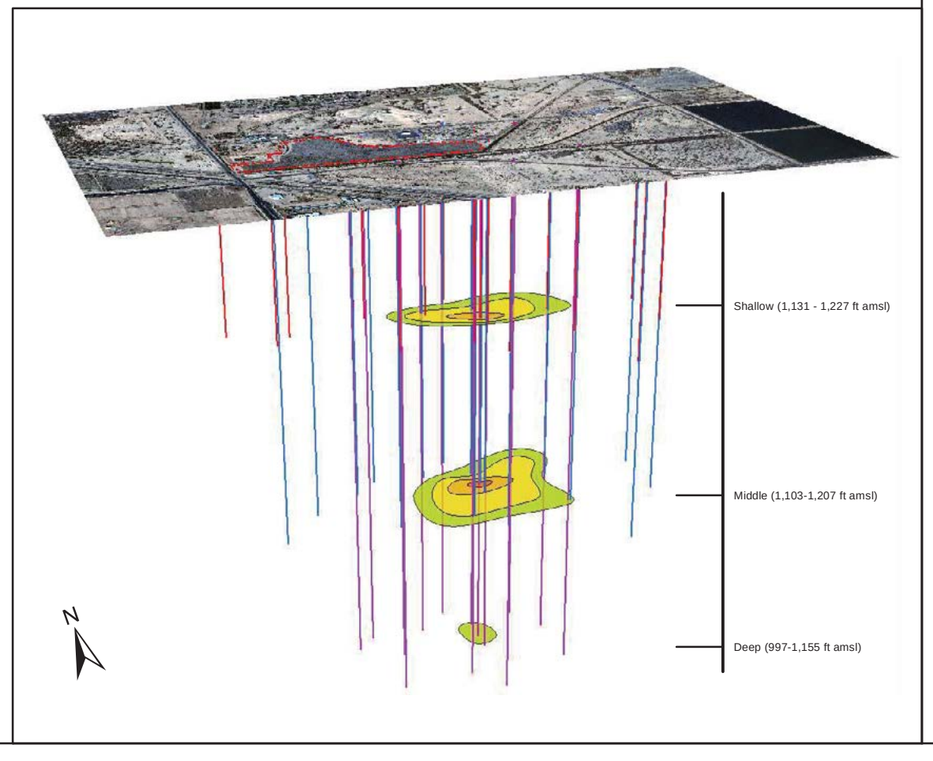
FIGURE **3-5**

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1" = 800'









Legend

TCE Concentrations (µg/L) in Groundwater (Dashed Where Inferred)

- *5-10 µg/L
- 10-20 µg/L
- 20-30 µg/L
- ≥30 µg/L

**AWQS/MCL = 5 µg/L*

- Groundwater Flow Direction
- Monitoring Well Location
- LF004 Boundary

Notes:

LF04-W11M *20*	Monitoring Well Identification Maximum TCE Concentration (µg/L) (Results that are ***italicized and bolded*** equal or exceed the AWQS MCL of 5 µg/L)
µg/L	Microgram per liter
<1	Not detected at or above the RL
AWQS	Arizona Aquifer Water Quality Standards
F	The analyte was positively identified but the associated concentration is an estimation above the MDL and below the RL
ft amsl	Feet above mean sea level
MCL	Environmental Protection Agency Maximum Contaminant Levels
MDL	Method Detection Limit
RL	Reporting Limit
TCE	Trichloroethene
U	The analyte was analyzed for, but not detected at or above the RL shown

0 200 400 800 Feet

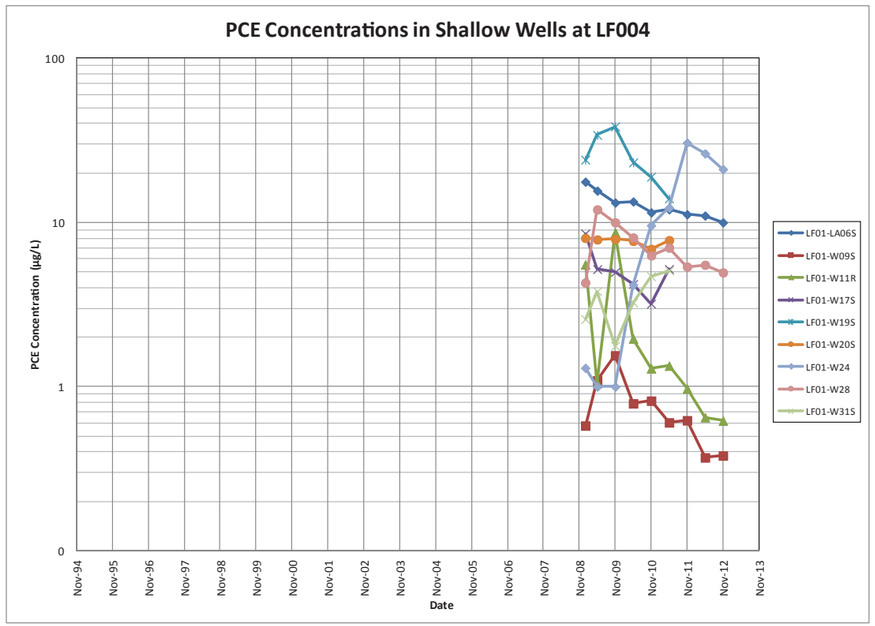
N

Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

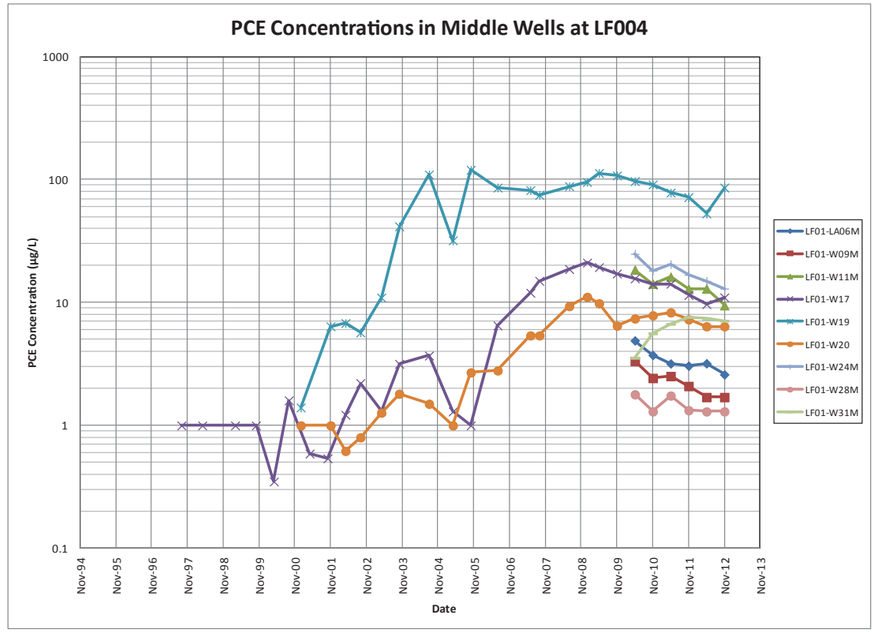
November 2012
TCE Concentrations in Groundwater by Depth

FIGURE **3-6**

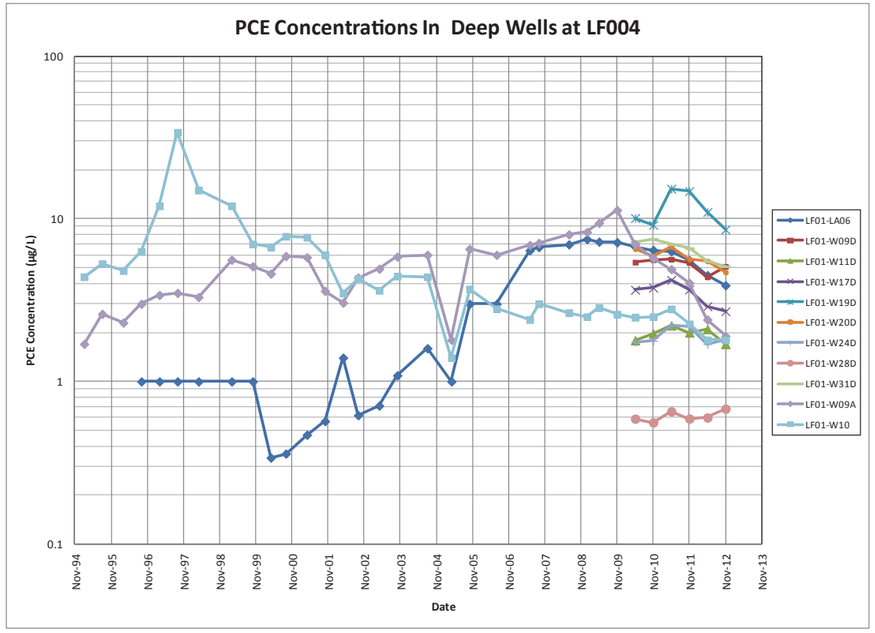
Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1" = 800'



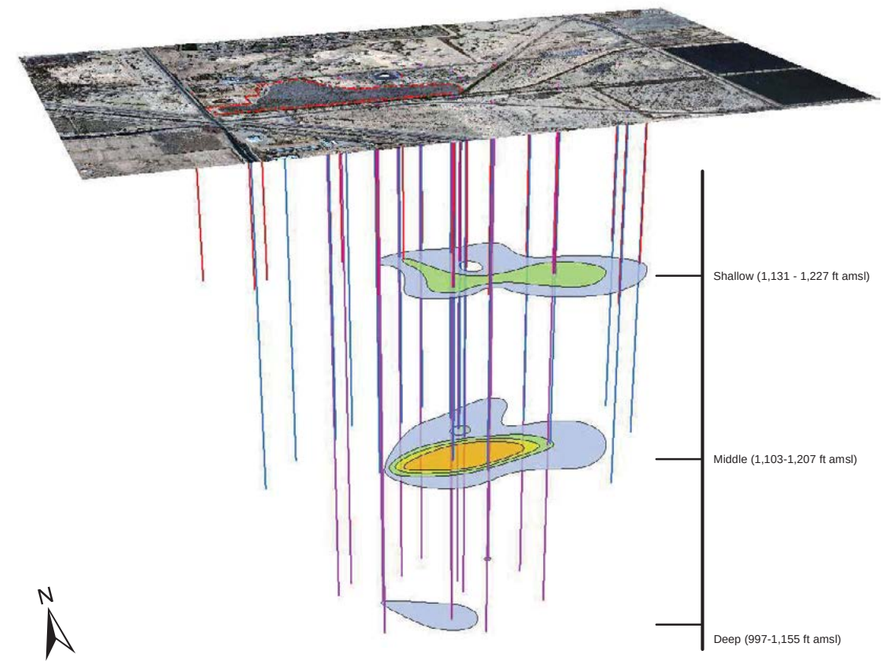
Shallow



Middle



Deep



Legend

PCE Concentrations (µg/L) in Groundwater

(See 3-D Graphic)

- *5-10 µg/L
- 10-20 µg/L
- 20-30 µg/L
- ≥30 µg/L

** AWQS/MCL = 5 µg/L*

Notes:

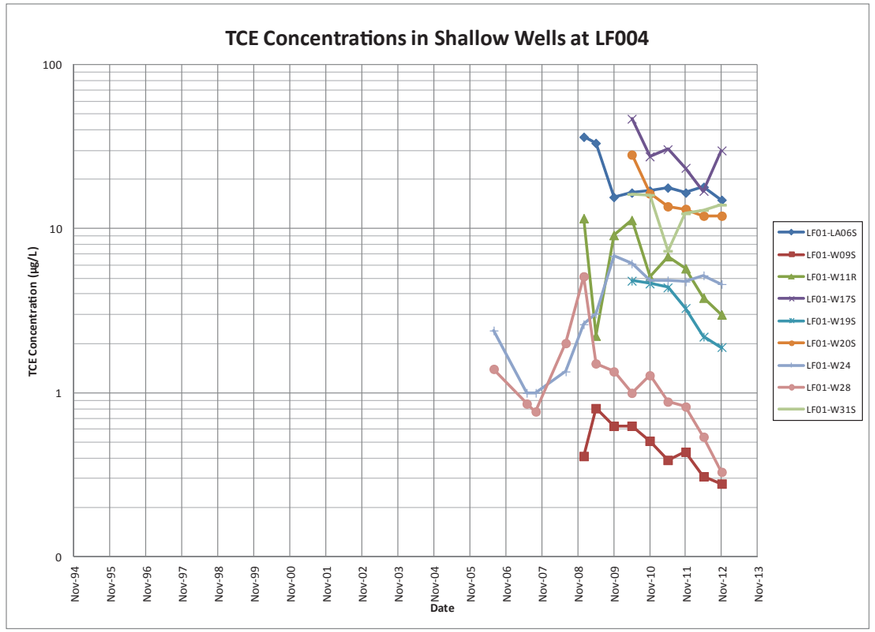
µg/L	Microgram per liter
AWQS	Arizona Aquifer Water Quality Standards
ft amsl	Feet above mean sea level
MCL	Environmental Protection Agency Maximum Contaminant Levels
PCE	Tetrachloroethene

Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

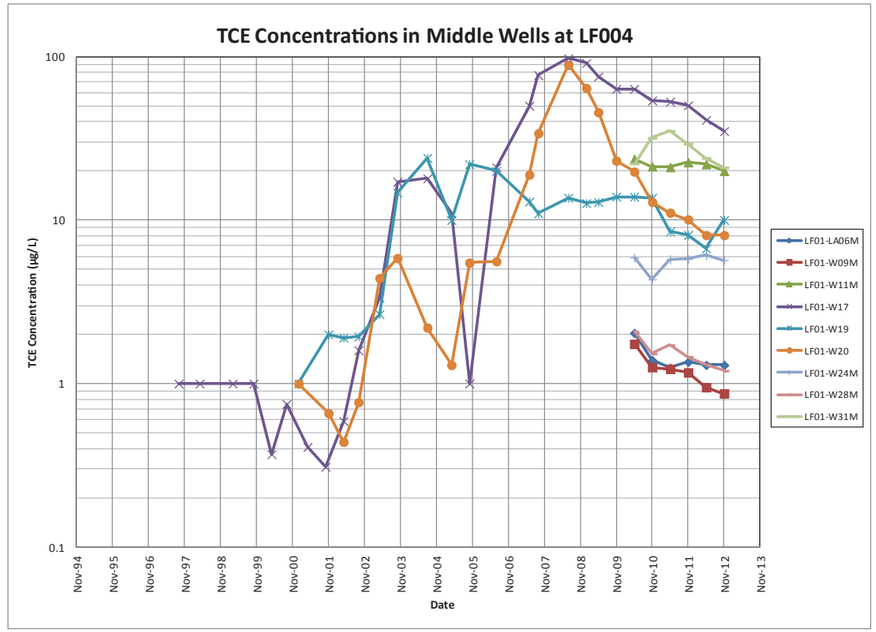
LF004 Depth Specific Distribution PCE Concentrations in Groundwater Over Time

FIGURE **3-7**

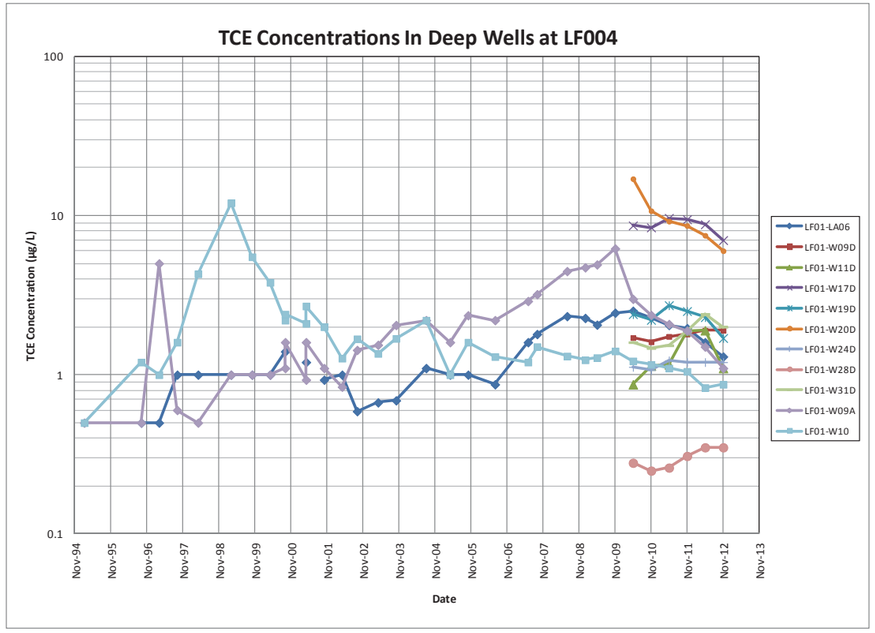
Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	Not to scale



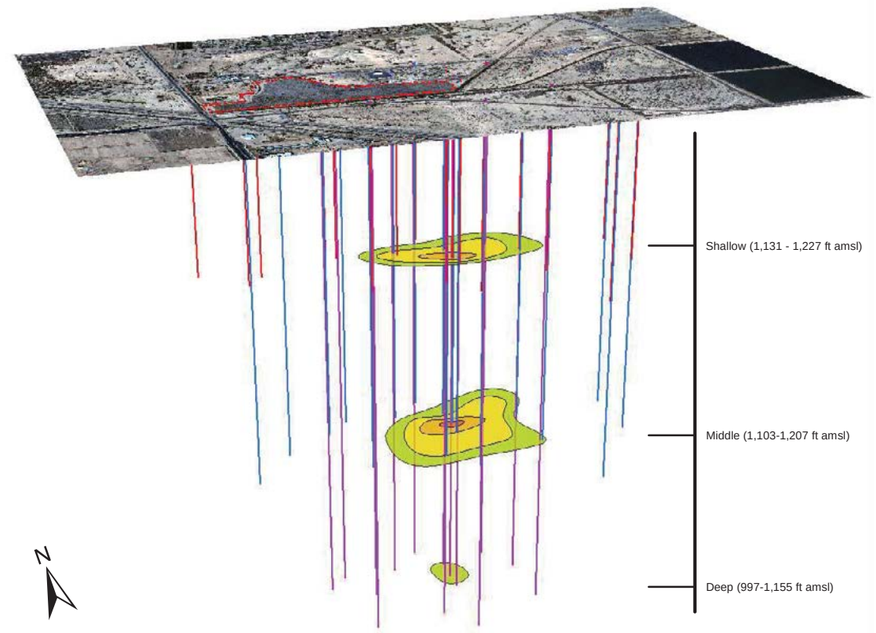
Shallow



Middle



Deep



Legend

TCE Concentrations (µg/L) in Groundwater

(See 3-D Graphic)

- *5-10 µg/L
- 10-20 µg/L
- 20-30 µg/L
- ≥30 µg/L

** AWQS/MCL = 5 µg/L*

Notes:

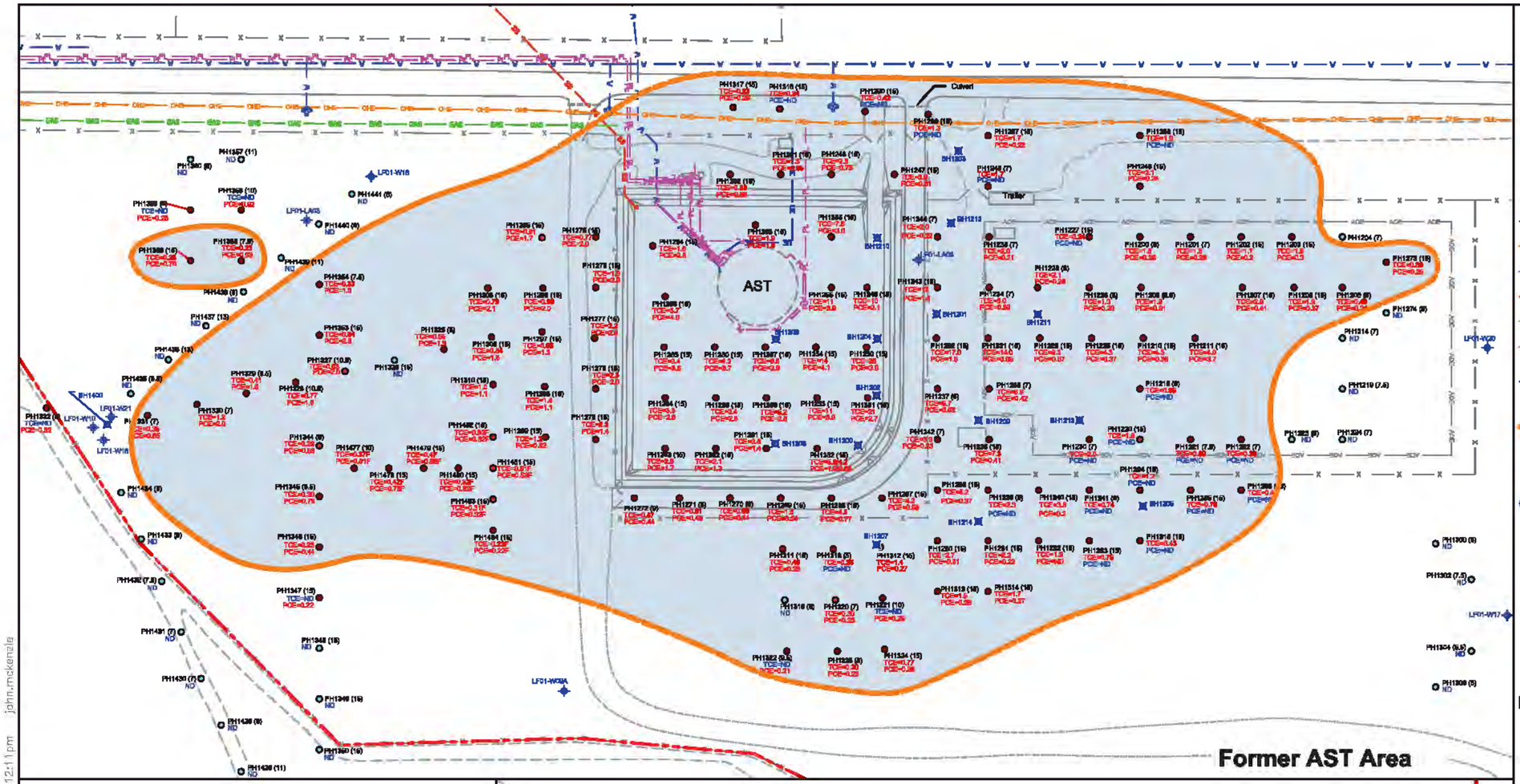
µg/L	Microgram per liter
AWQS	Arizona Aquifer Water Quality Standards
ft amsl	Feet above mean sea level
MCL	Environmental Protection Agency Maximum Contaminant Levels
TCE	Trichloroethene

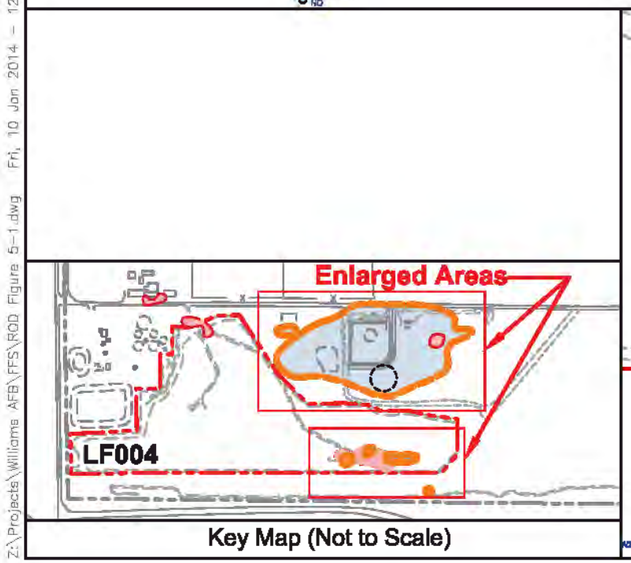
Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

LF004 Depth-Specific Distribution TCE Concentrations in Groundwater Over Time

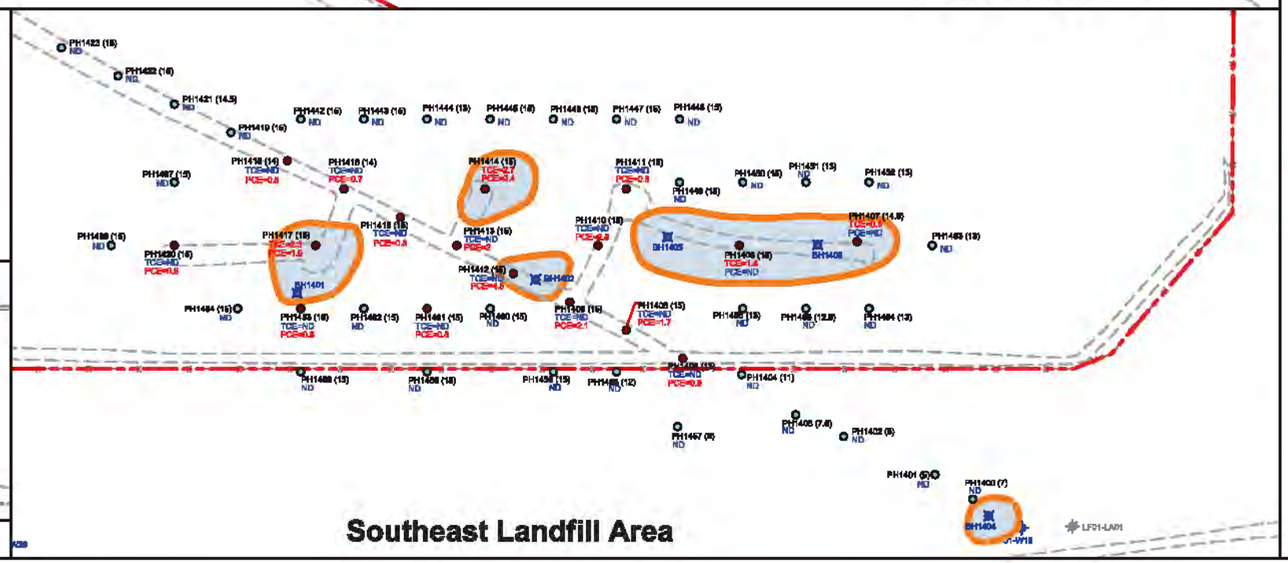
FIGURE **3-8**

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	Not to scale





Key Map (Not to Scale)



Legend

- Shallow Soil Gas Location (with no detections)
- Shallow Gas Location (with detections shown in red) (mg/m^3)
- Monitoring Well Location
- Deep Soil Boring Location
- Fence Line
- Overhead Power Line
- Water Line
- Storm Sewer Line
- Natural Gas Line
- Product Line
- Underground Power Line (Kinder Morgan Private Electric, HighVoltage - 480)
- Estimated Extent of Soil Gas Subject to RAOs (dashed where inferred)
- Estimated Extent of TCE or PCE Contamination in Shallow Soil Gas Subject to RAOs (>0.21 mg/m^3, i.e. the TCE Screening Level) (>4.2 mg/m^3, i.e. the PCE Screening Level)

F	Estimated Result. Associated Concentration is Above MDL and Below RL
PH1330 (7)	Location ID and Associated Sample Depth (ft bgs)
ND	Non Detect

Notes:
1. All utility locations are approximate only.
2. PCE above cleanup level is located within the TCE extent.

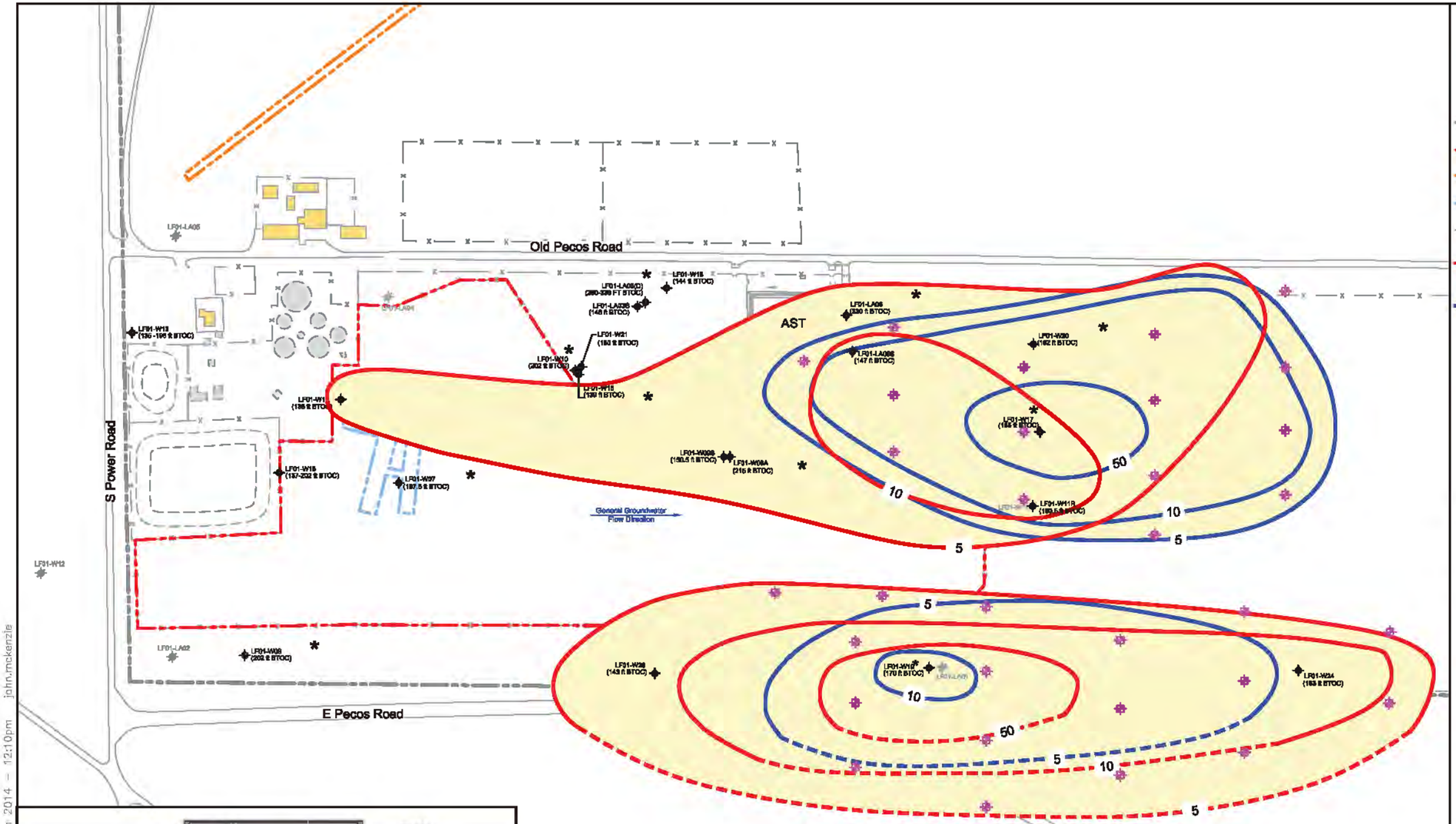
0 80 120 Feet

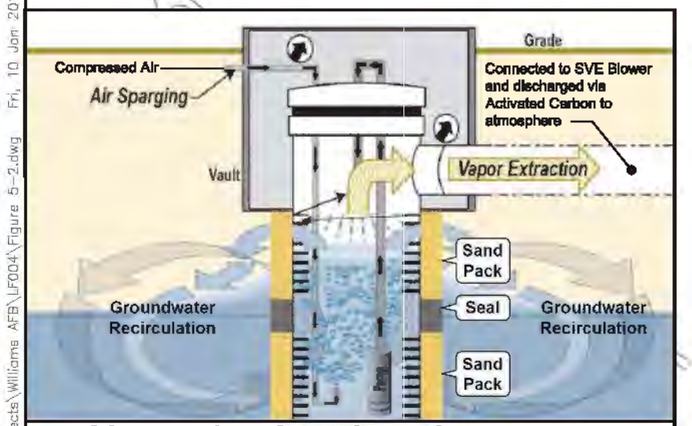
N

Final
ROD Amendment, OU-1 (LF004)
Former Williams Air Force Base
Mesa, Arizona

Extents of Shallow Soil Gas Contamination Subject to RAOs — FIGURE 5-1

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1"=120 Feet





SCHEMATIC DIAGRAM OF IWAS WELL AND GROUNDWATER RECIRCULATION (NOT TO SCALE)

Legend

- Existing Building/Structure
- Razed Building/Structure
- Former Williams AFB Boundary
- LF004 Boundary
- Southwest Drainage System
- Former Sewage Sludge Trenches
- Fence Line
- PCE Concentration Contour (µg/L) November 2010 (dashed where inferred)
- TCE Concentration Contour (µg/L) November 2010 (dashed where inferred)
- IWAS Well Locations
- Concentrations TCE and/or PCE >5 µg/L
- Decommissioned Monitoring Well Location
- Monitoring Well Location
- Well Screen Submerged
- ft BTOC — Feet Below Top of (Well) Casing
- IWAS — In-Well Air Stripping
- FFS — Focused Feasibility Study

Notes:

1. Contours based on maximum result used from PDB samples or submersible pump sample (if available) at each well.
2. Approximate sample depth for maximum result shown in parenthesis.
3. Well locations are conceptual only. Actual well locations and implementation phases will be presented in the Remedial Design/Remedial Action Work Plan.

0 175 350 Feet

N

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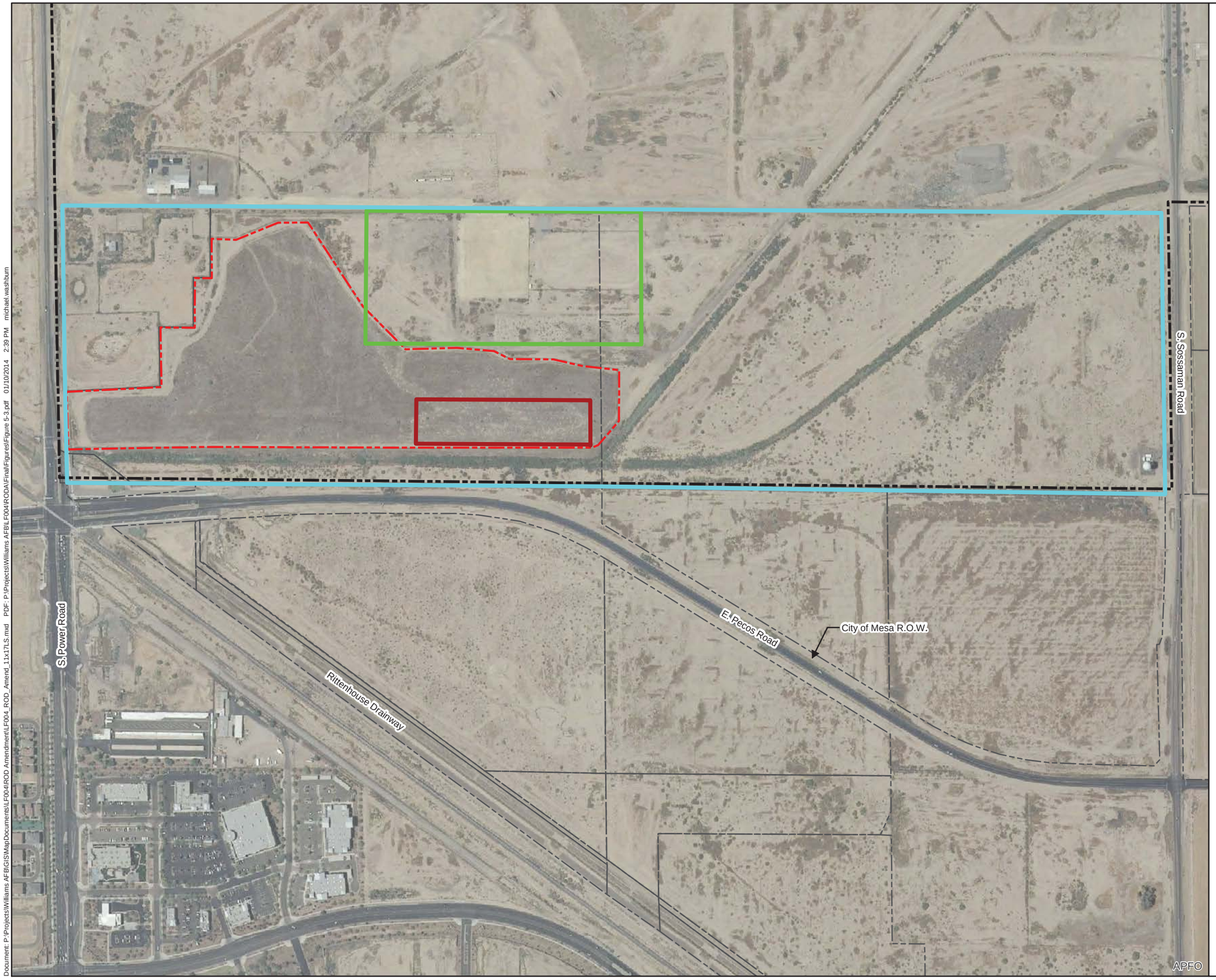
Mesa, Arizona

Conceptual FFS IWAS Well Layout — FIGURE **5-2**

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1"=350 Feet



Legend

- Former Williams AFB Boundary
- Parcel Line
- LF004 Site Boundary
- Boundary of Groundwater Institutional Controls (until cleanup levels achieved)
- Boundary of Southeast Landfill Area Shallow Soil Gas Institutional Controls (until risk-based Remedial Action Objectives achieved)
- Boundary of Former AST Area Shallow Soil Gas Institutional Controls (until risk-based Remedial Action Objectives achieved)

NAIP Arizona imagery (2010) accessed via ArcGIS image service:
http://gis.apfo.usda.gov/ArcGIS/services/NAIP/Arizona_2010_1m_NC/ImageServer

0 225 450 900 Feet

N

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Former Williams Air Force Base
Mesa, Arizona

Institutional Controls Compliance Boundaries

FIGURE **5-3**

Job No.	9101110001
PM:	EW
Date:	01/10/2014
Scale:	1" = 450 feet

Document: P:\Projects\Williams AFB\GISMapDocuments\LF004ROD AmendmentLF004_ROD_Amend_11x17LS.mxd PDF: P:\Projects\Williams AFB\LF004\RODAI\Final\Figures\Figure 5-3.pdf 01/10/2014 2:39 PM michael.washburn

APPENDIX A

CHEMICALS IDENTIFIED IN GROUNDWATER AND SOIL GAS AT LF004

Table A-1 Chemicals Identified in Shallow Soil Gas at LF004[1]

Contaminant	Frequency of Detection	Range of Contaminant Concentration (mg/m^3)	Average Contaminant Concentration (mg/m^3)	Location of Maximum Concentration	Screening Level[2] (mg/m^3)
Tetrachloroethene	141/283	0.2 – 4.6	1.7	PH1266	4.2 (NC)-9.4(C)
Trichloroethene	129/283	0.2 – 26	2.8	PH1250	0.21(NC)=0.43(C)
cis-1,2-Dichloroethene	0/283	NA	NA	NA	-[3]
trans-1,2-Dichloroethene	0/283	NA	NA	NA	6.3(NC)

Notes:

[1] Contaminants and result summary listed are from the shallow soil gas screening investigation during the supplemental RI. Shallow soil gas was analyzed by field analytical instruments for PCE, TCE, cis-1,2-dichloroethene, and trans-1,2-dichloroethene only.

[2] Screening levels are from the U.S. Environmental Protection Agency Regional Screening Levels for residential indoor air with an attenuation factor of 0.01 applied between soil gas and indoor air. Carcinogenic (C) RSL values are adjusted to $1x10^{-5}$ carcinogenic risk. Noncarcinogenic (NC) RSL values are at a hazard index of 1

[3] A residential indoor air RSL does not exist for cis-1,2-Dichloroethene.

Table A-2 Chemicals Identified in Deep Soil Gas at LF004[1]

Contaminant	Frequency of Detection	Range of Contaminant Concentration (mg/m^3)	Average Contaminant Concentration (mg/m^3)	Location of Maximum Concentration	Screening Level[2] (mg/m^3)
1,1,1-Trichloroethane	1/124	0.014	0.014	BH1405-20	520 (NC)
1,1,2-Trichlorotrifluoroethane	5/124	0.037 – 0.58	0.164	BH1102-125	3,100(NC)
1,1-Dichloroethane	10/124	0.026 – 0.55	0.144	BH1402-140	1.5(C)
1,1-Dichloroethene	4/124	0.033 – 2.7	0.780	BH1102-125	21(NC)
1,4-Dichlorobenzene	1/124	0.012	0.012	BH1405-20	0.22(C)-83(NC)
2-Butanone (MEK)	18/124	0.017 – 0.53	0.182	BH1403-135	520(NC)
2-Hexanone	11/124	0.0053 – 0.086	0.042	BH1403-135	3.1(NC)
4-Methyl-2-pentanone	1/124	0.0063	0.006	BH1405-20	310(NC)
Acetone	20/124	0.055 – 5.7	1.864	BH1405-120	3,200(NC)
Benzene	7/124	0.019 – 0.18	0.056	BH1102-125	0.31(C)-3.1(NC)
Bromodichloromethane	3/124	0.0064 – 0.063	0.030	BH1101-125	0.066(C)
Carbon disulfide	5/124	0.0049 – 0.062	0.025	BH1102-125	73(NC)
Carbon tetrachloride	12/124	0.014 – 0.53	0.182	BH1401-120	0.41(C)-10(NC)
Chloroform	19/124	0.0066 – 1.1	0.266	BH1405-20	0.011(C)-10(NC)
Chloromethane	1/124	0.0052	0.005	BH1405-20	9.4(NC)
Ethylbenzene	1/124	0.12	0.120	BH1102-125	0.97(C)-100(NC)

Contaminant	Frequency of Detection	Range of Contaminant Concentration (mg/m^3)	Average Contaminant Concentration (mg/m^3)	Location of Maximum Concentration	Screening Level[2] (mg/m^3)
Methylene chloride	6/124	0.0079 – 0.16	0.072	BH1405-60	63(NC)-96(C)
Styrene	1/124	0.042	0.042	BH1102-125	100(NC)
Tetrachloroethene	95/124	0.098 – 31	2.420	BH1402-140	4.2(NC)-9.4(C)
Toluene	13/124	0.014 – 0.45	0.106	BH1102-125	520(NC)
Trichloroethene	119/124	0.026 – 76	13.346	BH1207-120	0.21(NC)-0.43(C)
Trichlorofluoromethane	19/124	0.013 – 0.94	0.262	BH1404-130	73(NC)
Vinyl acetate	4/124	0.033 – 0.11	0.081	BH1403-135/BH1404-130	21(NC)
cis-1,2-Dichloroethene	1/124	0.033 – 0.32	0.310	BH1210-140	-[3]
m+p-Xylene	6/124	0.01 – 0.41	0.096	BH1102-125	10(NC)
o-Xylene	2/124	0.0055 – 0.13	0.068	BH1102-125	10(NC)
trans-1,2-Dichloroethene	2/124	0.026 – 0.25	0.138	BH1210-140	6.3(NC)

Notes:

[1] Contaminants and result summary listed are from the laboratory analytical results for the deep soil gas investigation during the supplemental RI.

[2] Screening levels are from the U.S. Environmental Protection Agency Regional Screening Levels (RSL) for residential indoor air with an attenuation factor of 0.01 applied between soil gas and indoor air. Carcinogenic (C) RSL values are adjusted to $1x10^{-5}$ carcinogenic risk. Noncarcinogenic (NC) RSL values are at a hazard index of 1.

[3] A residential indoor air RSL does not exist for cis-1,2-Dichloroethene.

Table A-3 COCs/COPCs Identified in Groundwater Monitoring Wells at LF004[8]

Contaminant	November 2012 Groundwater Monitoring[3]				Historical groundwater Data (2000-2012)[5]		
	Frequency of Detection[1]	Range of Detected Concentrations (µg/L)	Location of Maximum Concentration	Average Concentration[2] (µg/L)	Maximum Concentration (µg/L)	Date of Maximum Concentration	Location of Maximum Concentration
Organics							
Acetone	121/148	1.90 - 17	LF01-W18-WG-152-1112	5.1	430	6/1/2012	LF01-W31M-WG-168-0512
Benzene	--[1]	--[1]	--[1]	--[1]	1.6	10/29/2001	LF01-W11
Bis(2-ethylhexyl)phthalate[6]							
Bromodichloromethane (Dichlorobromomethane)	--[1]	--[1]	--[1]	--[1]	0.54	10/4/2000	LF01-W09A
1,1-dichloroethene	1/148	0.16	LF01-W14-WG-136-1112		1	4/10/2001	LF01-W14
cis-1,2-Dichloroethene	--[1]	--[1]	--[1]	--[1]	0.91	10/23/2000	LF01-W16
Methylene chloride (Dichloromethane)	33/148	0.32 - 0.59	LF01-W14-WG-202-1112	0.46	2.72	12/8/2009	WG-LF01-W17S-010
Tetrachloroethene (PCE)	128/148	0.20 - 86	LF01-W19-WG-181-1112	6.0	137.5	1/24/2005	LF01-W19-01/24/05
Toluene	--[1]	--[1]	--[1]	--[1]	12	10/29/2001	LF01-W11
trans-1,2-Dichloroethene	--[1]	--[1]	--[1]	--[1]	--[1]	--[1]	
Trichloroethene (TCE)	118/148	0.16 - 35	LF01-W17-WG-161-1112	4.7	97.6	7/9/2008	WG-LF01-W17-D1-030
Vinyl Chloride	--[1]	--[1]	--[1]	--[1]	0.18	6/26/2007	WG-LF01-W09A-D2-011
Inorganics							
Antimony[7]							
Beryllium[7]							
Cadmium[7]							
Carbon Disulfide[7]							
Chromium	--[4]	--[4]	--[4]	--[4]	0.0032	1/15/2007	WG-LF004-LF01-W19-010A
Copper[7]							
Lead[7]							
Manganese	--[4]	--[4]	--[4]	--[4]	0.106	7/15/2008	WG-LF01-LA06-031
Nickel[7]							
Nitrate[7]							
Selenium[7]							
Silver[7]							

Table A-3 COCs/COPCs Identified in Groundwater Monitoring Wells at LF004[8]

Contaminant	November 2012 Groundwater Monitoring[3]				Historical groundwater Data (2000-2012)[5]		
	Frequency of Detection[1]	Range of Detected Concentrations (µg/L)	Location of Maximum Concentration	Average Concentration[2] (µg/L)	Maximum Concentration (µg/L)	Date of Maximum Concentration	Location of Maximum Concentration
Uranium[7]							
Zinc	--[4]	--[4]	--[4]	--[4]	0.006	1/15/2007	WG-LF004-LF01-W19-010A

Notes:
COC – chemical of concern
COPC – chemical of potential concern
[1]If the concentration of the detected chemical is less than five times the concentration found in any blank (less than ten times for common laboratory contaminants), the chemical was not considered a detection.
[2]Average concentrations from the November 2012 sampling event include detected concentrations only.
[3]Source: AMEC, 2013d
[4]Analyte was not evaluated as part of investigations included in this summary.
[5]Compilation of data available in the site analytical database as reported in the following: IT, Groundwater Sampling Reports, April 2000 through September 2002; BEM Systems, Inc., LF004 Semi-Annual Groundwater Monitoring Data Reports, April 2003 through August 2004; URS Corporation, Groundwater Monitoring Reports, July 2006 through August 2012; AMEC Environment & Infrastructure, Inc., Groundwater Monitoring Reports, May 2012 through November 2012.
[6]Compound removed from monitoring program (laboratory contaminant).
[7]No analysis for compound. Analysis for inorganics was discontinued in 1999 by agreement between the AF, EPA, and ADEQ (Hydrogeologic, 2000).
[8]Regulatory limits for groundwater COCs/COPCs are summarized in Tables B-2 through and B-34 in Appendix B.

Table 4-3
Landfill (LF-04) Groundwater - Organic And Inorganic Constituents
Detected Constituents[a]
Page 1 of 2

	Well Number									
	LA-01		LA-02		LA-03		LA-04		LA-05	
Compound (ug/L)	[b]1/87 to 7/90	[c] 8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -
Semivolatiles										
Benzoic Acid					3J					
Bis(2-ethylhexyl)phthalate	3J	2J-15		1J	3J	2J-10	7J	4J-150	2J	2J-8J
Diethylphthalate						2BJ				
Di-n-butylphtalate							12			
Naphthalene										
Volatiles										
Acetone	2J				2J		5J			
Benzene		0.7	0.8	0.8-1.4		1		380		0.6-0.9
Bromodichloromethane										
Bromoform										
Carbon disulfide	3J									
Chloroform										
Dibromochloromethane										
Ethyl Benzene		1.4		0.6		4				0.5
Methylene Chloride	1.4-6		1.6-3.2		1.9-7.6		1.4-6		1.7-2.9	
PCE										
TCE										
Toluene		3.5		1.2		8		0.5-1.4		0.8
Xylene (Total)		4				10				
Other										
TPH	2		2000		1000-4000		1000			
Metals										
Antimony	36.6 J	19.2 B		22.2 J				21.3 J		37.7 B
Arsenic				2 B						
Beryllium		1.1 B				1 B		1 B		1.4 B
Bromide			900-1,000				1,200		1,300-1,700	
Cadmium			9				13		6-13	
Chromium		4 B-5.6J				5.7 B		16.2		4.3 B-8.2 J
Copper		8.1B-10B		12.5 B		10B-11.1 B	9	10.7 J		6.8B-9.1 B
Lead		1.3B-2.6B	11	1.1 B-5.7		1B-1.2 B	90	1.3B-10.1	90	1J-2.9B
Maganese			0.24-0.27							
Mercury			0.3	0.24			0.3			
Nickel		9.8 B						15.3-16J	50	12.1 J
Nitrate	17,000-64,000	21,500	11,000-84,000	21,300	4,000-15,000	5,000	19,000-84,000	24,400	20,000-91,000	26,400
Selenium	1.4 J	1.6 B		1.2B-2B		2B-3.8 B		1.5 J	1.1J	1.7J-2.8B
Silver	3.4 J	7B-7,300	14	6.4-8.4B	7.9 B	5.7B-8.6 B	18	4.5B-7.7 B	13	3B-5.5B
Thallium		1.2 B		1.1 B						1 J
Uranium	0.003		0.003		0.003		0.003		0.005	
Zinc	1,100-1,900	21.6-158	20-1,600	13.1B-68.2	250-1,200	16.2B-456	430-1,800	18.3B-260	200-1,600	31.8-423

WAFB\TABLES\RODM-3.WK3\WI0-1-93

Table 4-3
Landfill (LF-04) Groundwater - Organic And Inorganic Constituents
Detected Constituents [a]
Page 2 of 2

	Well Number										
	LA-06		LF-01-W-07		LF-01-W-08		LF-01-W-09 A		LF-01-W-10	LF-01-W-11	LF-01-W-12
Compound (ug/L)	[b] 1/87 to 7/90	[c] 8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	8/90 -	8/90 -	8/90 -
Semivolatiles											
Benzoic Acid											
Bis(2-ethyl hexyl)phthalate			2J	3J-8J		2J-3J				7J	3J
Diethylphthalate								3J			3J
Di-n-butylphtalate				0.9J				3BJ			
Naphthalene											2J
Volatiles											
Acetone											
Benzene				0.5				0.9-6.1	2.7	0.9	
Bromodichloromethane				0.6	0.5	0.6-1.1					
Bromoform									0.8		
Carbon disulfide											
Chloroform				0.9	0.8	0.6-1.2					
Dibromochloromethane				0.5-0.8		0.9-1.2					
Ethyl Benzene		0.7		1.2				1.8-5.8	4		
Methylene chloride	1.8										
PCE			1-1.2	1.2-2.5	1.7-1.9	1.5-3.3		1-1.4	2.2-4.3		
TCE	0.7-0.8	0.5-0.7			1.2-1.4	1.2-2.4			0.9		
Toluene		1.2		1-1.5		0.5		4.4-18	0.6-10	0.9-3.9	
Xylene (Total)		2		4		1		4-16		4	
Other											
TPH			2000		2						
Metals											
Antimony		29.5 J		23.2 B		54.9 B					106
Arsenic		1.1 B		1.8B-1.9 B	2.4B	1.8 B-17.7		1.6 B			11.3
Beryllium		1J-1.5B		1.1 J		1 J-1.9 B		1.1B-1.3 J	1.3 J		
Bromide	900										
Cadmium	14	4 B								2.5B	
Chromium		4.3J-9.2 J		10.6-1,200		80.9-6,020		4B-1,100	8.1J-1,930	3.8B-822	3.8B-11,000
Copper			59.2	19.8B-45.9		6B-202		12.6B-24B	30	18.8-28.3	68.9
Lead		4.8-12.3	5	1.6B-2.1B		1.1B-2.4 B		1B-2.3J	1 J		
Maganese			0.1		0.09			80			
Mercury									0.22		
Nickel	30	10.6B-13.8 J	120-15,000	121-222	230	59-244	237	158-1,098	3.23J-202	51.5-270	64.5-1,080
Nitrate	17,000-91,000		6,000		13,000-17,100				21,700	13,200	9,800
Selenium		1.2 B		1 B-2.4 B		2.7 B		1B-2.4B		1J	
Silver	13	3.2B-9.5 B		5 B-11.6		4.4 B-11.1		6.1J-13.9	5.6 J	5J-7.9B	6.9 B
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Uranium	.002									16.7B-47.5	6.8B-125
Zinc	1,200-2,700	374-522	70	23.8-34.4	80	13.5B-96.4	20.5	32.7-50	71.9		

WAFB\TABLES\RODM-1.WK3\JR-24-94

Notes:
[a] - the data presented is divided into collection times from 1/87 to 7/90 and 8/90 on to facilitate analysis of data that was not validated (collected from 1/87 to 7/90) and data that has been validated (collected from 8/90 on)
[b] 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.
[c] 8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.

APPENDIX B

IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601 *et seq*., establishing the Superfund program to address remediation of National Priority List (NPL) sites. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. Promulgated regulations to implement the program are found in Title 40 of the Code of Federal Regulations (CFR), Part 300, also known as the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Compliance with applicable or relevant and appropriate requirements (ARARs) is a statutory requirement of CERCLA and is one of nine criteria for remedial alternative evaluations [40 CFR 430(e)(9)(iii)(B)]. Accordingly, this appendix identifies the ARARs for LF004 at the Former Williams Air Force Base (AFB).

The ARARs identification process was conducted in accordance with the following:

- CERCLA, Section 121(d)(2)(A);
- Title 40 CFR Part 300 [specifically, Sections 300.5 and 300.400(g)];
- U.S. Environmental Protection Agency (EPA), ***RCRA, Superfund and EPCRA Hotline Training Module,*** EPA 540-R-98-020, June 1998;
- EPA, ***ARARs Q's and A's: General Policy, RCRA, CWA, SDWA, Post-ROD Information, and Contingent Waivers,*** Publication 9234.2-01/FS-A, July 1991;
- EPA, ***RCRA ARARs: Focus on Closure Requirements,*** Directive 9234.2-04FS, October 1989;
- EPA, ***CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements,*** EPA/540/G-89/009, August 1989;
- EPA, ***CERCLA Compliance with Other Laws Manual: Interim Final***, EPA/540/G-89/006, August 1988.

The terms *applicable requirements* and *relevant and appropriate requirements* are defined in 40 CFR Section 300.5 as follows:

> *Applicable requirements* means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.
>
> *Relevant and appropriate requirements* means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing

> laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

ARARs may be federal, state, or local requirements. Local requirements are recognized as ARARs if they are enforceable by the state. The requirement must be legally enforceable for evaluation as a potential ARAR. Guidelines and voluntary standards are not legally enforceable and are evaluated separately as potential "to be considered" guidelines (TBCs) [40 CFR 300.400(g)(3)]. TBCs are not legally enforceable, but become enforceable when included in an approved record of decision (ROD). Identification of TBCs is not mandatory, but are typically identified when useful in developing CERCLA remedies (e.g., when ARARs do not exist or are not fully protective).

In making a determination of whether a particular requirement under an environmental law may be applicable or relevant and appropriate, a two-part analysis that is based on the site-specific conditions was performed in accordance with 40 CFR 300.400(g). The first part of the analysis entails making a determination of whether the requirement is applicable. If the requirement is applicable, it is an ARAR and no further analysis is needed. If a determination is made that the requirement is not applicable, then a determination of whether the requirement is relevant and appropriate must be made. EPA (August 1988) provides substantial guidance in determining whether requirements are relevant and appropriate. The basic considerations are whether the requirement (1) regulates or addresses problems or situations sufficiently similar to those encountered at the CERCLA site (i.e., relevance), and (2) is appropriate to the circumstances of the release or threatened release, such that its use is well suited to the particular site. If the requirement is relevant and appropriate, it is an ARAR.

ARARs are typically divided into three categories: chemical, location, and action.

- Chemical-specific ARARs are typically risk-based standards, requirements, criteria, or limitations which when applied to the site yield numerical limitations for acceptable amounts of a particular chemical that may be present in an environmental media.
- Location-specific ARARs are typically standards, requirements, criteria, or limitations that are placed on activities conducted at certain locations due to the unique nature of the location.
- Action-specific ARAR are typically standards, requirements, criteria, or limitations that are placed on remedial actions that affect hazardous substances.

Table B-1 summarizes the identification process.

For off-site actions, both *substantive* and *administrative* requirements apply directly and independently of the CERCLA ARARs provision and process. CERCLA Section 121(e) exempts on-site actions from *permit* requirements; only *substantive* requirements are considered potential ARARs for on-site actions. A discussion of *substantive* versus *administrative*

requirements is found in ***CERCLA Compliance with Other Laws Manual*** (EPA, August 1988), Section 1.2.2.1:

> *Substantive* requirements are those requirements that pertain directly to actions or conditions in the environment. Examples of substantive requirements include quantitative health- or risk-based restrictions upon exposure to types of hazardous substances (e.g., MCLs establishing drinking water standards for particular contaminants), technology-based requirements for actions taken upon hazardous substances (e.g., incinerator standards requiring particular destruction and removal efficiency), and restrictions upon activities in certain special locations (e.g., standards prohibiting certain types of facilities in floodplains).
>
> *Administrative* requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation. Administrative requirements include the approval of, or consultation with administrative bodies, consultation, issuance of permits, documentation, reporting, record keeping, and enforcement. In general administrative requirements prescribe methods and procedures by which substantive requirements are made effective for purposes of a particular environmental or public health program.

The selected remedy in the ROD must satisfy all ARARs, unless one or more of the following six waivers are obtained [40 CFR Section 300.430(f)(1)(ii)(C)]:

1. The alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant and appropriate federal or state requirement;
2. Compliance with the requirement will result in greater risk to human health and the environment than other alternatives;
3. Compliance with the requirement is technically impracticable from an engineering perspective;
4. The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach;
5. With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state; or
6. For Fund-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund monies to respond to other sites that may present a threat to human health and the environment.

A review of these waivers for those ARARs identified in Table B-1 was performed. No waivers to these ARARs appears warranted.

Tables B-2, B-3, and B-4 present the numerical cleanup levels and screening levels and identification of the associated chemical-specific ARARs. The LF004 FFS indicated Arizona AWQSs as the basis for the preliminary remediation goals for groundwater for several

compounds. The MCLs are cited in this ROD amendment as the basis for the cleanup levels or ARARs/TBCs where they are available and numerically equivalent to the AWQSs. This was done for consistency with policy to base cleanup levels on federal standards unless state and local standards are more restrictive.

Table B-1. Identification of ARARs and TBCs [(a)]

Type	Scope	Citation	Description	Overview of Requirements	Designation of Alternatives for Which Requirements are Applicable or Relevant and Appropriate		
					Applicable	Relevant and Appropriate	To Be Considered
Action	Federal	40 CFR Parts 144-147 (SDWA - 42 USC § 300)	Underground Injection Control Standards	Establishes regulations for subsurface injections. Regulations are designed to provide for protection of groundwater used for drinking water. Potentially applicable for alternatives that inject reagents into the subsurface.	5		--
Action	Federal	40 CFR Parts 260-265,268 (Solid Waste Disposal Act - 42 USC §§6901-6987)	Federal RCRA Hazardous Waste Management and Land Disposal Restrictions	Establishes federal rules for identifying, generating, transporting, treating, storing, and disposing of hazardous waste. Potentially applicable for disposal of soil cuttings from drilling or treatment media. Applicability would be determined based on analytical testing of these materials.	5	--	--
Action	Federal	49 CFR Parts 170-180 (Hazardous Materials Transportation Act,49 USC 1801 et seq)	Hazardous Materials Transportation	Transportation of wastes and materials which are hazardous materials (e.g., RCRA hazardous wastes, TSCA wastes, etc.) must be packaged, marked, placarded, and manifested in accordance with the HMTA regulations. Potentially applies for transportation of soil cuttings or waste treatment media.	5	--	--
Action	State	AAC, Title 18, Chapter 2	Air Pollution Control	These regulations govern point sources of air pollution, such as those from soil vapor extraction SVE units. ADEQ has established a general permit application for SVE Units, which incorporates the requirements of R18-2-702 (General Provisions) and R18-2-730 (Standards of Performance for Unclassified Sources). Would apply to alternatives with air emissions.	5	--	--

Table B-1. Identification of ARARs and TBCs [(a)](Continued)

Type	Scope	Citation	Description	Overview of Requirements	Designation of Alternatives for Which Requirements are Applicable or Relevant and Appropriate		
					Applicable	Relevant and Appropriate	To Be Considered
Action	County	Maricopa County Rule 330	Control of Air Contaminants – VOCs	Stipulates that no person shall discharge more than 40 lbs (18 kg) of VOCs into the atmosphere in any one day from any machine, equipment, device, or other article without using an acceptable air pollution control device. Would apply to alternatives with air emissions.	5	--	--
Action	State	ARS 49-152 and AAC R18-7-208	Recordation of a DEUR	If the owner has elected to leave contamination on the property that exceeds the applicable residential standard for the property, the owner shall record an institutional control that consists of a restrictive covenant that is labeled "declaration of environmental use restriction" pertaining to the area of the property necessary to protect the public health and the environment. DEUR is applicable as part of institutional controls if property is transferred prior to achieving the residential RAOs.		5	

Table B-1. Identification of ARARs and TBCs [(a)](Continued)

Type	Scope	Citation	Description	Overview of Requirements	Designation of Alternatives for Which Requirements are Applicable or Relevant and Appropriate		
					Applicable	Relevant and Appropriate	To Be Considered
Chemical	Federal	40 CFR Part 141 (SDWA - 42 USC § 300)	National Primary Drinking Water Standards	These regulations establish MCLs and MCLGs, which are used as drinking water standards for public water systems. MCLs are specified for a wide range of organic and inorganic analytes. Of particular note are the MCLs for PCE (5 µg/L) and TCE (5 µg/L).	--	B, 5	--
Chemical	Federal	EPA RSL available at: http://www.epa.gov/region9/superfund/prg /	EPA RSLs	Guidance that provides acceptable concentration levels in air for exposure to residents and industrial workers. Levels are determined with risk-based calculations considering appropriate exposure parameters and toxicity factors. Levels are provided for all COCs except cis-1,2-DCE.	--	--	B, 5
Chemical	State	AAC, Title 18, Chapter 11, Article 4	Aquifer Water Quality Standards	State regulations providing numerical standards for protection of aquifer water quality. Standards for COCs are the same as Federal MCLs (40 CFR Part 141).	B, 5	--	--
Location	Federal	36 CFR Part 800 Protection of Historic Properties	National Historic Preservation Act	Federal regulations that require Federal agencies to take into account the effects of their undertakings on historic properties and allow the Advisory Council on Historic Preservation to comment of the proposed undertakings. Would apply to portions of remediation conducted within the Southwest Germann archeological site.	B, 5	-	

Table B-1. Identification of ARARs and TBCs [(a)](Continued)

Type	Scope	Citation	Description	Overview of Requirements	Designation of Alternatives for Which Requirements are Applicable or Relevant and Appropriate		
					Applicable	Relevant and Appropriate	To Be Considered
Location	Federal	36 CFR Part 65 National Historic Landmarks Program	National Historic Landmarks Program	National Park Service program used to identify and designate National Historic Landmarks. Federal agencies undertaking a project having an effect on a listed or eligible property must provide the Advisory Council on Historic Preservation a reasonable opportunity to comment (36 CFR part 800). Also, the head of the responsible Federal agency must plan and act to minimize harm to landmarks, Would apply to portions of remediation conducted within the Southwest Germann archeological site.	B, 5	-	

Notes:

AAC – Arizona Administrative Code
ADEQ – Arizona Department of Environmental Quality
ARARs – Applicable or Relevant and Appropriate Requirements
ARS – Arizona Revised Statutes
AWQS – Aquifer Water Quality Standards
CERCLA – Comprehensive Environmental Response Compensation and Liability Act
CFR – Code of Federal Regulations
cis-1,2-DCE – cis-1,2-dichloroethene
COCs – contaminants of concern
DEUR – Declaration of Environmental Use Restriction
HMTA – Hazardous Materials Transportation Act
kg – kilogram
lbs – pounds
MCL - Maximum Containment Level
MCLG – Maximum Contaminant Level Goal
PCE – tetrachloroethene
RAOs – remedial action objectives
RCRA – Resource Conservation and Recovery Act
RSLs – Regional Screening Levels
SDWA – Safe Drinking Water Act
SVE – soil vapor extraction
TBC – to be considered
TCE – trichloroethene
TSCA – Toxic Substances Control Act
µg/L – micrograms per liter
USC – United States Code
VOCs – volatile organic compounds

Table B-2
Identification of Cleanup Levels in Groundwater
Landfill 004 (LF004)
Operable Unit 1
Williams Air Force Base, Arizona

Containment of Concern	Cleanup Level			
	Applicable	Relevant and Appropriate	To be Considered	Basis
Chemicals of Concern				
Tetrachloroethene		5		Federal MCL
Trichloroethene		5		Federal MCL

Notes:
All values listed are in micrograms per liter.

MCL - Maximum Containment Level

Table B-3
Identification of ARAR/TBC Levels in Groundwater for Contaminants of Potential Concern
Landfill 004 (LF004)
Operable Unit 1
Williams Air Force Base, Arizona

Containment of Potential Concern	ARAR/TBC Level[1]			
	Applicable	Relevant and Appropriate	To be Considered	Basis[1]
Degradation Products of Contaminants of Concern				
1,1-Dichloroethene		7		Federal MCL
cis-1,2-Dichloroethene		70		Federal MCL
trans-1,2-Dichloroethene		100		Federal MCL
Vinyl chloride		2		Federal MCL
Other Contaminants of Potential Concern from OU-1 ROD				
Acetone			12,000	EPA Tap Water RSL
Antimony		6		Federal MCL
Benzene		5		Federal MCL
Beryllium		4		Federal MCL
bis(2-ethylhexyl) phthalate		6		Federal MCL
Bromodichloromethane		100[2]		Federal MCL
Cadmium		5		Federal MCL
Carbon Disulfide			720	EPA Tap Water RSL
Chromium		100		Federal MCL
Copper		1,300[3]		Federal/Arizona Alert Level
Lead		15[4]		Federal/Arizona Alert Level
Manganese			320	EPA Tap Water RSL
Methylene Chloride		5		Federal MCL
Nickel	100			Arizona AWQS
Nitrate		10,000		Federal MCL

Containment of Potential Concern	ARAR/TBC Level[1]			
	Applicable	Relevant and Appropriate	To be Considered	Basis[1]
Selenium		50		Federal MCL
Silver			71	EPA Tap Water RSL
Toluene		1,000		Federal MCL
Uranium		10		Federal MCL
Zinc			4,700	EPA Tap Water RSL

Notes:

All values listed are in micrograms per liter.
Secondary MCLs not listed as these are not health-based standards and therefore not relevant and appropriate.
[1]Federal MCLs used if established. Relevant and appropriate state standard used where Federal MCLs don't exist. EPA tap water RSLs used where no applicable or relevant and appropriate federal or state numerical standard identified.
[2]Value listed is total for all trihalomethanes.
[3]Treatment technique and public notification action level at 15 µg/L.
[4]Alert level
AWQS – Aquifer Water Quality Standards
Cr III – trivalent chromium
Cr VI – hexavalent chromium
MCL - Maximum Containment Level

Table B-4
Identification of Screening Levels – Soil Gas
Landfill 004 (LF004)
Operable Unit 1
Williams Air Force Base, Arizona

Containment	Soil Gas Screening Level[1,2,3]	
	Criteria To be Considered	Basis
Chemicals of Concern		
Tetrachloroethene	4,200-9,400	EPA Indoor Air Residential Noncarcinogenic and Carcinogenic RSL[3]
Trichloroethene	210-430	EPA Indoor Air Residential Noncarcinogenic and Carcinogenic RSL[3]

Notes:
All values listed are in micrograms per cubic meter.
[1]Taken from EPA *RSL Residential Air Table*. November 2013. Accessed online 15 January 2013, at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/docs/resair_sl_table_run_NOV2013.pdf
[2]Screening values listed include attenuation factor of 0.01 from slab-on-grade subslab soil gas to indoor air (EPA, 2002 and 2012).
[3]Values listed are based on carcinogenic risk of $1x10^{-5}$ and noncarcinogenic hazard index of 1 (HI=1),.
EPA – United States Environmental Protection Agency
RSL – Regional Screening Level

APPENDIX C

LF004 COST ESTIMATE

Table C-1: Cost Estimate Summary

Alternative	Description	Capital Cost		O&M Cost					Totals
		Description	Cost	Description	Cost	Period	Annual Equivalent	Present Value[2]	
5A	In-Well Air Stripping and SVE (32 IWAS Wells)	Design	$ 365,700	IWAS/SVE O&M Years 1-10[1]	$4,159,002	10	$ 415,900	$4,068,949	
		Construction	$5,073,309	Long Term Management (5-Year Reviews and Semiannual Monitoring)	$ 979,733	10	$ 65,316	$ 639,013	
	Subtotal		$5,439,009		$5,138,735			$4,707,962	
	Total Alternative Cost (Non-discounted)								$10,577,744
	Total Present Value Alternative Cost								$10,146,971
5B	In-Well Air Stripping, Oxidation, and SVE (20 IWAS, 20 Ozone)	Design	$ 360,007	IWAS/SVE O&M Years 1-5[1]	$1,931,361	5	$ 386,272	$1,908,399	
		Construction	$5,304,293	Long Term Management (5-Year Reviews and Semiannual Monitoring)	$ 979,733	10	$ 65,316	$ 639,013	
	Subtotal		$5,664,300		$2,911,094			$2,547,412	
	Total Alternative Cost (Non-discounted)								$ 8,575,394
	Total Present Value Alternative Cost								$ 8,211,712

Notes:

[1] Includes only two years of SVE operation and maintenance

[2] Real Discount Rates (from Appendix C of White House Office of Management and Budget Circular A-94, December 2011)

5-Year 0.4%
20-Year 1.7%
30-Year 2.0%

Estimate Documentation Report

System:

RACER Version: 10.4.0
Database Location: C:\Users\rob.singer\Documents\001.Projects\MISC RACER\Williams\Williams AFB.mdb

Folder:

Folder Name: Williams AFB

Project:

Project ID: LF004-Alternative 5a - In-well Air Stripping
Project Name: LF004-Alternative 5a - In-well Air Stripping
Project Category: None

Location

State / Country: ARIZONA
City: WILLIAMS AFB

Location Modifier	Default	User
	0.994	0.994

Options

Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description: In-well Air Stripping

Estimate Documentation Report

Site Documentation:

Site ID: LF004 - In-well Air Stripping
Site Name: LF004 - In-well Air Stripping
Site Type: None

Media/Waste Type
Primary: Groundwater
Secondary: Soil

Contaminant
Primary: Volatile Organic Compounds (VOCs)
Secondary: None

Phase Names
Pre-Study: ☐
Study: ☐
Design: ☑
Removal/Interim Action: ☐
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☐

Documentation
Description: LF004 - In-well Air Stripping
Support Team:
References:

Estimator Information
Estimator Name: Robert Singer, P.E.
Estimator Title: Sr. Engineer
Agency/Org./Office: AMEC Environment & Infrastructure
Business Address: 511 Congress St.
Portland, ME 04101
Telephone Number: 207-828-2643
Email Address: rob.singer@amec.com
Estimate Prepared Date: 01/13/2012

Estimator Signature: _____ Date: _____

Reviewer Information
Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:

Estimate Documentation Report

Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ Date: _____

Estimated Costs:

Phase Names	Direct Cost	Marked-up Cost
RD -IWAS	$0	$365,700
IWAS	$3,459,285	$5,073,309
IWAS (yr 1-5)	$1,425,995	$2,191,040
IWAS (yr 6-10)	$1,325,240	$1,967,962
Long Term Management	$496,330	$979,733
Total Cost:	$6,706,851	$10,577,744

Estimate Documentation Report

Phase Documentation:

Phase Type: Design Percent Method
Phase Name: RD -IWAS
Description: RD for IWAS

Total Capital Costs are the marked up costs for the items listed below, excluding the Professional Labor Management, Administrative Land Use Controls, and Operations and Maintenance technologies. Only the first year costs are included for cost-over-time technologies.

Phase Name	Phase Date	Design Approach	Total Capital Cost	Design %	Design Costs	Design Cost Year
IWAS	January, 2013	In Situ Treatment	$4,571,255	8.00	$365,700	2012

Total Design Cost: $365,700

Estimate Documentation Report

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	IWAS
Description:	32 ART wells that include: recirculation pump, air sparge, and SVE. Note that AS and SVE points are installed in the existing extraction well, so drilling costs are excluded.
Approach:	In Situ
Start Date:	January, 2013
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Groundwater Extraction Wells	Yes	100	0
Professional Labor Management	Yes	100	0
Air Sparging	Yes	100	0
Soil Vapor Extraction	Yes	100	0
Overhead Electrical Distribution	Yes	100	0
Carbon Adsorption (Gas)	Yes	100	0
Soil Vapor Extraction	Yes	100	0

Total Marked-up Cost: $5,073,309

Technologies:

Estimate Documentation Report

Technology Name: Groundwater Extraction Wells (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Number of Wells		32	EA
Flow Rate per Well		30	GPM
Type of Formation		Unconsolidated	n/a
Depth to Base of Contamination		260	FT
Type of Aquifer		Unconfined	n/a
Depth to Static Water Table		140	FT
Depth to Top of Confining Layer		0	FT
Depth to Bottom of Confining Layer		0	FT
Type of Existing Cover		Soil/Gravel	n/a
Safety Level		D	n/a
Pumps & Wells			
Secondary Parameters			
Type of Submersible Pump	4" Submersible Pump, 21-32 GPM, 281"< Head <=340", 3 hp, w/ controls	4" Submersible Pump, 21-32 GPM, 281"< Head <=340", 3 hp, w/ controls	n/a
Casing Diameter	6 inches	6 inches	IN
Wells Enclosure	Restricted Zone/Above Ground	Restricted Zone/Above Ground	n/a
Wells Screen Length	20	20	FT
Drum Drill Cuttings		Yes	n/a
Pipes & Tanks			
Secondary Parameters			
Pipe Location		Above Ground	n/a
Pipe Type	PVC, Schedule 80	PVC, Schedule 80	n/a
Pipe Length	50	300	FT
Effluent Collection Tank		Yes	n/a
Effluent Collection Tank Type	5,000 GAL, Single Wall Steel Tank	5,000 GAL, Single Wall Steel Tank	n/a
Number of Effluent Collection Tanks	1	1	EA

Comments:

Estimate Documentation Report

Technology Name: Professional Labor Management (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Markedup Construction Cost ($)		4,523,010	$
Percentage	11.1	11.1	%
Dollar Amount		502,054	$

Comments:

Estimate Documentation Report

Technology Name: Air Sparging (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Soil Type		Gravel/Gravel-Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Groundwater		140	FT
Depth to Base of Contamination		260	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		260	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Air Rotary	n/a
Well Diameter		2 Inch	n/a
Well Construction Material		PVC Schedule 80	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Safety Level		D	n/a
Air Sparge Points			
Secondary Parameters			
Quantity of Air Sparge Points	305	32	EA
Air Flow Rate per Well	5	5	CFM
Equipment Enclosure		Yes	n/a

Comments: Delete all drilling-related costs.
Assume 300 LF of distribution piping/well
Use 30 HP air compressor instead of blower

Estimate Documentation Report

Technology Name: Soil Vapor Extraction (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Installation Type		Vertical Wells	n/a
Soil Type		Gravel/Gravel Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Base of Contamination		260	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		140	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Hollow Stem	n/a
Well Diameter		2 Inch	n/a
Well Construction Material		PVC Schedule 40	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Drilling Safety Level		D	n/a
Vertical Wells			
Secondary Parameters			
Vertical Well: Extraction Well Spacing	100	200	FT
Vertical Well: Number of Vapor Extraction Wells	49	32	EA
Vertical Well: Average Vapor Flow Rate per Well	150	150	CFM
Vertical Well: Total Vapor Flow Rate	7,350	4,800	CFM
Vertical Well: Knockout Drums	0	2	EA
Vertical Well: Floor Slab Sawing	0	0	HR
Vertical Well: Equipment Enclosure	No	No	n/a

Comments: Delete all drilling and well related costs
Assume 300 LF of field pipe per well

Estimate Documentation Report

Technology Name: Overhead Electrical Distribution (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Type of Distribution		5 KV 3 Phase Primary	n/a
Distance		2,000	LF
Safety Level		D	n/a
Specification			
Secondary Parameters			
Pole Spacing	250	250	LF
Electric Wire Type	160 AMP Service	160 AMP Service	n/a
Electric Pole Length	12.19 m (40 FT) Pole	12.19 m (40 FT) Pole	n/a

Comments:

Technology Name: Carbon Adsorption (Gas) (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Influent Flow Rate		4,800	CFM
Adsorption System		Dual Bed Carbon Adsorption Units	n/a
Know Total Organic Concentration		No	n/a
Influent Total Organic Concentration (for O&M)		0	ppm
System Redundancy		Two Adsorbers in Series	n/a
Blower		No	n/a
Heater		No	n/a
Safety Level		D	n/a

Comments:

Estimate Documentation Report

Technology Name: Soil Vapor Extraction (# 2)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Installation Type		Vertical Wells	n/a
Soil Type		Sand/Gravelly Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Base of Contamination		85	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		85	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Air Rotary	n/a
Well Diameter		4 Inch	n/a
Well Construction Material		PVC Schedule 80	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Drilling Safety Level		D	n/a
Vertical Wells			
Secondary Parameters			
Vertical Well: Extraction Well Spacing	50	200	FT
Vertical Well: Number of Vapor Extraction Wells	196	13	EA
Vertical Well: Average Vapor Flow Rate per Well	35	70	CFM
Vertical Well: Total Vapor Flow Rate	6,860	910	CFM
Vertical Well: Knockout Drums	0	2	EA
Vertical Well: Floor Slab Sawing	0	0	HR
Vertical Well: Equipment Enclosure	No	No	n/a

Comments: The well depth, and flow rates are averages based on 5 wells @140 ft, 100 cfm plus 8 wells @50 ft, 50 cfm

Estimate Documentation Report

Phase Documentation:

Phase Type: Operations & Maintenance
Phase Name: IWAS (yr 1-5)
Description:

Start Date: February, 2013
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate
Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Operations and Maintenance	Yes	100	0

Total Marked-up Cost: $2,191,040

Technologies:

Estimate Documentation Report

Technology Name: Operations and Maintenance

Description	Default	Value	UOM
Labor			
Secondary Parameters			
Operations Labor: Type	Moderate	Moderate	n/a
Professional Labor: Type	Exclude from Estimate	Minimum	n/a
Analytical			
Secondary Parameters			
Wastewater/Effluent: Sampling Frequency	Monthly	Monthly	n/a
Wastewater/Effluent: Primary Analytical Template	System - Wastewater Effluent	System - Wastewater Effluent	n/a
Wastewater/Effluent: Secondary Analytical Template	None	None	n/a
Air Emissions: Sampling Frequency	Annually	Annually	n/a
Air Emissions: Primary Analytical Template	System Air Emissions - VOCs	System Air Emissions - VOCs	n/a
Air Emissions: Secondary Analytical Template	None	None	n/a
Solid Wastes: Sampling Frequency	Exclude from Estimate	Exclude from Estimate	n/a
Solid Wastes: Primary Analytical Template	None	None	n/a
Solid Wastes: Secondary Analytical Template	None	None	n/a
Heating Requirements			
Secondary Parameters			
Air Streams: Flow Rate	4,800	4,800	CFM
Air Streams: Temperature Difference	20	20	F
Air Streams: Months per Year	12	12	Month
Water Streams: Flow Rate	960	960	CFM
Water Streams: Temperature Difference	0	0	F
Water Streams: Months per Year	0	0	Month
Facility: Area	2,025	2,025	SF
Facility: Temperature Difference	0	0	F
Facility: Months per Year	0	0	Month

Comments: 1) RACER will not allow modeling of O&M for AS/SVE beyond 60 months. The modeled costs for years 1 through 5 will be duplicated for the out years, through year 10.

Estimate Documentation Report

Technology Name: Groundwater Extraction Wells (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Number of Wells		32	EA
Flow Rate per Well		30	GPM
Type of Aquifer		Unconfined	n/a
Depth to Static Water Table		140	FT
Depth to Top of Confining Layer		0	FT

Technology Name: Air Sparging (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Quantity of Air Sparge Points		32	EA
Air Flow Rate per Well		5	CFM

Technology Name: Soil Vapor Extraction (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Installation Type		Vertical Wells	n/a
Average Well Depth		140	LF
Vertical Well: Number of Vapor Extraction Wells		32	EA
Vertical Well: Total Vapor Flow Rate		4,800	CFM
Horizontal Trenches: Total Vapor Flow Rate		0	CFM

Estimate Documentation Report

Technology Name: Carbon Adsorption (Gas) (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Influent Flow Rate		4,800	CFM
Adsorption System		Dual Bed Carbon Adsorption Units	n/a
Influent Total Organic Concentration (for O&M)		0	ppm

Technology Name: Soil Vapor Extraction (# 2) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Installation Type		Vertical Wells	n/a
Average Well Depth		85	LF
Vertical Well: Number of Vapor Extraction Wells		13	EA
Vertical Well: Total Vapor Flow Rate		910	CFM
Horizontal Trenches: Total Vapor Flow Rate		0	CFM

Estimate Documentation Report

Phase Documentation:

Phase Type: Operations & Maintenance
Phase Name: IWAS (yr 6-10)
Description:

Start Date: February, 2018
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate
Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Operations and Maintenance	Yes	100	0

Total Marked-up Cost: $1,967,962

Technologies:

Estimate Documentation Report

Technology Name: Operations and Maintenance

Description	Default	Value	UOM
Labor			
Secondary Parameters			
Operations Labor: Type	Moderate	Moderate	n/a
Professional Labor: Type	Exclude from Estimate	Minimum	n/a
Analytical			
Secondary Parameters			
Wastewater/Effluent: Sampling Frequency	Monthly	Monthly	n/a
Wastewater/Effluent: Primary Analytical Template	System - Wastewater Effluent	System - Wastewater Effluent	n/a
Wastewater/Effluent: Secondary Analytical Template	None	None	n/a
Air Emissions: Sampling Frequency	Annually	Annually	n/a
Air Emissions: Primary Analytical Template	System Air Emissions - VOCs	System Air Emissions - VOCs	n/a
Air Emissions: Secondary Analytical Template	None	None	n/a
Solid Wastes: Sampling Frequency	Exclude from Estimate	Exclude from Estimate	n/a
Solid Wastes: Primary Analytical Template	None	None	n/a
Solid Wastes: Secondary Analytical Template	None	None	n/a
Heating Requirements			
Secondary Parameters			
Air Streams: Flow Rate	4,800	4,800	CFM
Air Streams: Temperature Difference	20	20	F
Air Streams: Months per Year	12	12	Month
Water Streams: Flow Rate	960	960	CFM
Water Streams: Temperature Difference	0	0	F
Water Streams: Months per Year	0	0	Month
Facility: Area	2,025	2,025	SF
Facility: Temperature Difference	0	0	F
Facility: Months per Year	0	0	Month

Comments: 1) RACER will not allow modeling of O&M for AS/SVE beyond 60 months. The modeled costs for years 1 through 5 will be duplicated for the out years, through year 10.

Estimate Documentation Report

Technology Name: Groundwater Extraction Wells (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Number of Wells		32	EA
Flow Rate per Well		30	GPM
Type of Aquifer		Unconfined	n/a
Depth to Static Water Table		140	FT
Depth to Top of Confining Layer		0	FT

Technology Name: Air Sparging (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Quantity of Air Sparge Points		32	EA
Air Flow Rate per Well		5	CFM

Technology Name: Soil Vapor Extraction (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Installation Type		Vertical Wells	n/a
Average Well Depth		140	LF
Vertical Well: Number of Vapor Extraction Wells		32	EA
Vertical Well: Total Vapor Flow Rate		4,800	CFM
Horizontal Trenches: Total Vapor Flow Rate		0	CFM

Estimate Documentation Report

Technology Name: Carbon Adsorption (Gas) (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Influent Flow Rate		4,800	CFM
Adsorption System		Dual Bed Carbon Adsorption Units	n/a
Influent Total Organic Concentration (for O&M)		0	ppm

Estimate Documentation Report

Phase Documentation:

Phase Type:	Long Term Monitoring
Phase Name:	Long Term Management
Description:	Five-year reviews for years 2016, 2021, 2026, 2031, 2036, 2041, including cost for site visits and reporting. Costs for long-term semiannual monitoring for VOCs at LF004 for 30 years. Includes 25 wells (average) for years 1 (2012) through 30 (2041).
Start Date:	January, 2012
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Five-Year Review	Yes	100	0
MONITORING	Yes	100	0
Residual Waste Management	Yes	100	0

Total Marked-up Cost: $979,733

Technologies:

Estimate Documentation Report

Technology Name: Five-Year Review (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Site Complexity		Moderate	n/a
Document Review		No	n/a
Interviews		No	n/a
Site Inspection		Yes	n/a
Report		Yes	n/a
Travel		No	n/a
Rebound Study		No	n/a
Start Date		January-2016	n/a
No. Reviews		6	EA
Site Inspection			
Required Parameters			
General Site Inspection		Yes	n/a
Containment System Inspection		No	n/a
Monitoring Systems Inspection		Yes	n/a
Treatment Systems Inspection		No	n/a
Regulatory Compliance		Yes	n/a
Site Visit Documentation (Photos, Diagrams, etc.)		Yes	n/a
Report			
Required Parameters			
Introduction		Yes	n/a
Remedial Objectives		Yes	n/a
ARARs Review		Yes	n/a
Summary of Site Visit		Yes	n/a
Areas of Non Compliance		Yes	n/a
Technology Recommendations		Yes	n/a
Statement of Protectiveness		Yes	n/a
Next Review		Yes	n/a
Implementation Requirements		Yes	n/a

Comments: Costs for 5-Year Reviews, in years 2016, 2021, 2026, 2031, 2036, 2041

Estimate Documentation Report

Technology Name: Monitoring (# 1)
User Name: MONITORING

Description	Default	Value	UOM
System Definition			
Required Parameters			
Model Name		MONITORING	n/a
Groundwater		Yes	n/a
Surface Soil		No	n/a
Surface Water		No	n/a
Subsurface Soil		No	n/a
Sediment		No	n/a
Soil Gas		No	n/a
Air		No	n/a
Site Distance (One-way)		30	MI
Safety Level		D	n/a
Groundwater			
Required Parameters			
Average Sample Depth		180	FT
Samples per Event (First Year)		25	n/a
Samples per Event (Out Years)		25	n/a
Number of Events (First Year)		2	n/a
Number of Events (Out Years)		2	n/a
Number of Years (Out Years)		9	n/a
Secondary Parameters			
Primary Analytical Template	System Water - VOCs	System Water - VOCs	n/a
Secondary Analytical Template	None	None	n/a
Turnaround Time	Standard (21 Days)	14 Day	n/a
Data Package/QC	Stage 1	Stage 1	n/a
Sampling Method	Existing Wells - Low Flow Pump	Existing Wells - Low Flow Pump	n/a
Number of Wells/Day	4	4	EA
Contain Purge Water	Yes	Yes	n/a
QA/QC			
Secondary Parameters			
Split Samples	1: 10	1: 10	EA
Field Duplicate Samples	1: 10	1: 10	EA

Estimate Documentation Report

Technology Name: Monitoring (# 1)
User Name: MONITORING

Description	Default	Value	UOM
QA/QC			
Secondary Parameters			
Rinse Blanks (per Round)	1	1	EA
Trip Blanks (per Day)	1	1	EA
Matrix Spikes/Matrix Spike Duplicates	1: 20	1: 20	EA
Data Management			
Secondary Parameters			
Monitoring Plan	Standard	None	n/a
Lab Data Review	Stage 1	Stage 1	n/a
Submit Data Electronically	Yes	Yes	n/a
Monitoring Reports	Abbreviated	Abbreviated	n/a

Comments:

Technology Name: Residual Waste Management (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Safety Level		D	n/a
Non-Rad Disposal			
Required Parameters			
Waste Type / Condition		Non-Hazardous Drums	n/a
Total Quantity		1,709	Drums
Transportation Type		Truck	n/a
Truck Distance (One-way)		50	Miles

Comments: Assume 1 Drum/Well/Event = 1 drum x 25 wells x 2 events per year x 10 years ***QUANTITY IN ESTIMATE DOCUMENTATION REPORT DOES NOT REFLECT THE COCRRECT NUMBER OF DRUMS. THE ACTUAL COST ACCOUNTS FOR 500, NOT 5125.

Estimate Documentation Report

System:

RACER Version: 10.4.0
Database Location: C:\Users\rob.singer\Documents\001.Projects\MISC RACER\Williams\Williams AFB.mdb

Folder:

Folder Name: Williams AFB

Project:

Project ID: LF004-Alternative 5b - In-well AS+ PerO3
Project Name: LF004-Alternative 5b - In-well AS+ PerO3
Project Category: None

Location
State / Country: ARIZONA
City: WILLIAMS AFB

Location Modifier	Default	User
	0.994	0.994

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description: In-well Air Stripping

Estimate Documentation Report

Site Documentation:

Site ID:	LF004-Alternative 5b - In-well AS+ PerO3
Site Name:	LF004-Alternative 5b - In-well AS+ PerO3
Site Type:	None

Media/Waste Type

Primary:	Groundwater
Secondary:	Soil

Contaminant

Primary:	Volatile Organic Compounds (VOCs)
Secondary:	None

Phase Names

Pre-Study:	☐
Study:	☐
Design:	☑
Removal/Interim Action:	☐
Remedial Action:	☑
Operations & Maintenance:	☑
Long Term Monitoring:	☑
Site Closeout:	☐

Documentation

Description:	LF004-Alternative 5b - In-well AS+ PerO3
Support Team:	
References:	

Estimator Information

Estimator Name:	Robert Singer, P.E.
Estimator Title:	Sr. Engineer
Agency/Org./Office:	AMEC Environment & Infrastructure
Business Address:	511 Congress St. Portland, ME 04101
Telephone Number:	207-828-2643
Email Address:	rob.singer@amec.com
Estimate Prepared Date:	01/13/2012

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:	
Reviewer Title:	
Agency/Org./Office:	
Business Address:	

Estimate Documentation Report

Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ Date: _____

Estimated Costs:

Phase Names	Direct Cost	Marked-up Cost
RD for IWAS + Perozone Sparging	$0	$360,007
IWAS	$3,672,109	$5,304,293
IWAS + Perozone	$1,245,465	$1,931,361
Long Term Management	$496,330	$979,733
Total Cost:	$5,413,904	$8,575,395

Estimate Documentation Report

Phase Documentation:

Phase Type: Design Percent Method
Phase Name: RD for IWAS + Perozone Sparging
Description: RD for IWAS + Perozone Sparging

Total Capital Costs are the marked up costs for the items listed below, excluding the Professional Labor Management, Administrative Land Use Controls, and Operations and Maintenance technologies. Only the first year costs are included for cost-over-time technologies.

Phase Name	Phase Date	Design Approach	Total Capital Cost	Design %	Design Costs	Design Cost Year
IWAS	January, 2013	In Situ Treatment	$4,500,086	8.00	$360,007	2012

Total Design Cost: $360,007

Estimate Documentation Report

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	IWAS
Description:	20 ART wells that include: recirculation pump, air sparge, and SVE. Note that AS and SVE points are installed in the existing extraction well, so drilling costs are excluded from the AS and SVE points for the ART System 20 Perozone sparge points would be constructed with an 8-inch boring to same depth as ART wells. There is no screen or casing but there would be three sparge points installed at different depths There would be two ozone/sparing systems (one for each hot spot) and assocatiated tubing to wells in each hot spot.
Approach:	In Situ
Start Date:	January, 2013
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Professional Labor Management	Yes	100	0
Groundwater Extraction Wells	Yes	100	0
Air Sparging	Yes	100	0
Soil Vapor Extraction	Yes	100	0
Overhead Electrical Distribution	Yes	100	0
Carbon Adsorption (Gas)	Yes	100	0
Air Sparging	Yes	100	0
Soil Vapor Extraction	Yes	100	0

Total Marked-up Cost: $5,304,293

Technologies:

Estimate Documentation Report

Technology Name: Professional Labor Management (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Markedup Construction Cost ($)		4,752,305	$
Percentage	10.6	10.6	%
Dollar Amount		503,744	$

Comments:

Estimate Documentation Report

Technology Name: Groundwater Extraction Wells (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Number of Wells		20	EA
Flow Rate per Well		30	GPM
Type of Formation		Unconsolidated	n/a
Depth to Base of Contamination		260	FT
Type of Aquifer		Unconfined	n/a
Depth to Static Water Table		140	FT
Depth to Top of Confining Layer		0	FT
Depth to Bottom of Confining Layer		0	FT
Type of Existing Cover		Soil/Gravel	n/a
Safety Level		D	n/a
Pumps & Wells			
Secondary Parameters			
Type of Submersible Pump	4" Submersible Pump, 21-32 GPM, 281"< Head <=340", 3 hp, w/ controls	4" Submersible Pump, 21-32 GPM, 281"< Head <=340", 3 hp, w/ controls	n/a
Casing Diameter	6 inches	6 inches	IN
Wells Enclosure	Restricted Zone/Above Ground	Restricted Zone/Above Ground	n/a
Wells Screen Length	20	20	FT
Drum Drill Cuttings		Yes	n/a
Pipes & Tanks			
Secondary Parameters			
Pipe Location		Above Ground	n/a
Pipe Type	PVC, Schedule 80	PVC, Schedule 80	n/a
Pipe Length	50	50	FT
Effluent Collection Tank		Yes	n/a
Effluent Collection Tank Type	5,000 GAL, Single Wall Steel Tank	5,000 GAL, Single Wall Steel Tank	n/a
Number of Effluent Collection Tanks	1	1	EA

Comments:

Estimate Documentation Report

Technology Name: Air Sparging (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Soil Type		Gravel/Gravel-Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Groundwater		140	FT
Depth to Base of Contamination		260	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		260	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Air Rotary	n/a
Well Diameter		2 Inch	n/a
Well Construction Material		PVC Schedule 80	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Safety Level		D	n/a
Air Sparge Points			
Secondary Parameters			
Quantity of Air Sparge Points	305	20	EA
Air Flow Rate per Well	5	5	CFM
Equipment Enclosure		Yes	n/a

Comments: Delete all drilling-related costs.
Assume 300 LF of distribution piping/well
Use 30 HP air compressors instead of blowers

Estimate Documentation Report

Technology Name: Soil Vapor Extraction (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Installation Type		Vertical Wells	n/a
Soil Type		Gravel/Gravel Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Base of Contamination		260	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		140	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Hollow Stem	n/a
Well Diameter		2 Inch	n/a
Well Construction Material		PVC Schedule 40	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Drilling Safety Level		D	n/a
Vertical Wells			
Secondary Parameters			
Vertical Well: Extraction Well Spacing	100	200	FT
Vertical Well: Number of Vapor Extraction Wells	49	20	EA
Vertical Well: Average Vapor Flow Rate per Well	150	150	CFM
Vertical Well: Total Vapor Flow Rate	7,350	3,000	CFM
Vertical Well: Knockout Drums	0	2	EA
Vertical Well: Floor Slab Sawing	0	0	HR
Vertical Well: Equipment Enclosure	No	No	n/a

Comments: Delete all drilling and well related costs
Assume 300 LF of field pipe per well

Estimate Documentation Report

Technology Name: Overhead Electrical Distribution (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Type of Distribution		5 KV 3 Phase Primary	n/a
Distance		2,000	LF
Safety Level		D	n/a
Specification			
Secondary Parameters			
Pole Spacing	250	250	LF
Electric Wire Type	160 AMP Service	160 AMP Service	n/a
Electric Pole Length	12.19 m (40 FT) Pole	12.19 m (40 FT) Pole	n/a

Comments:

Technology Name: Carbon Adsorption (Gas) (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Influent Flow Rate		3,000	CFM
Adsorption System		Dual Bed Carbon Adsorption Units	n/a
Know Total Organic Concentration		No	n/a
Influent Total Organic Concentration (for O&M)		0	ppm
System Redundancy		Two Adsorbers in Series	n/a
Blower		No	n/a
Heater		No	n/a
Safety Level		D	n/a

Comments:

Estimate Documentation Report

Technology Name: Air Sparging (# 2)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Soil Type		Gravel/Gravel-Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Groundwater		140	FT
Depth to Base of Contamination		260	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		260	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Air Rotary	n/a
Well Diameter		4 Inch	n/a
Well Construction Material		PVC Schedule 80	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Safety Level		D	n/a
Air Sparge Points			
Secondary Parameters			
Quantity of Air Sparge Points	305	20	EA
Air Flow Rate per Well	5	5	CFM
Equipment Enclosure		Yes	n/a

Comments: Delete all drilling-related costs.
Assume 300 LF of distribution piping/well
Delete AS blower and add ozone generation system
Add 3 sparge points per borehole with average 200 LF of pipe
Add 60 Perozone sparge heads at $5000/each

Estimate Documentation Report

Technology Name: Soil Vapor Extraction (# 2)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Installation Type		Vertical Wells	n/a
Soil Type		Sand/Gravelly Sand Mixture	n/a
Surface Area of Contamination		383,000	SF
Depth to Base of Contamination		85	FT
Safety Level		D	n/a
Drilling			
Required Parameters			
Average Well Depth		85	LF
Formation Type		Unconsolidated	n/a
Drilling Method		Air Rotary	n/a
Well Diameter		4 Inch	n/a
Well Construction Material		PVC Schedule 80	n/a
Split Spoon Sample Collection		No	n/a
Drum Drill Cuttings		No	n/a
Average Number of Soil Samples per Well		0	EA
Soil Analytical Template		None	n/a
Drilling Safety Level		D	n/a
Vertical Wells			
Secondary Parameters			
Vertical Well: Extraction Well Spacing	50	200	FT
Vertical Well: Number of Vapor Extraction Wells	196	13	EA
Vertical Well: Average Vapor Flow Rate per Well	35	70	CFM
Vertical Well: Total Vapor Flow Rate	6,860	910	CFM
Vertical Well: Knockout Drums	0	2	EA
Vertical Well: Floor Slab Sawing	0	0	HR
Vertical Well: Equipment Enclosure	No	No	n/a

Comments: The well depth, and flow rates are averages based on 5 wells @140 ft, 100 cfm plus 8 wells @50 ft, 50 cfm

Estimate Documentation Report

Phase Documentation:

Phase Type: Operations & Maintenance
Phase Name: IWAS + Perozone
Description: Run For 5 Years

Start Date: February, 2013
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate
Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
Operations and Maintenance	Yes	100	0

Total Marked-up Cost: $1,931,361

Technologies:

Estimate Documentation Report

Technology Name: Operations and Maintenance

Description	Default	Value	UOM
Labor			
Secondary Parameters			
Operations Labor: Type	High	High	n/a
Professional Labor: Type	Exclude from Estimate	Minimum	n/a
Analytical			
Secondary Parameters			
Wastewater/Effluent: Sampling Frequency	Monthly	Monthly	n/a
Wastewater/Effluent: Primary Analytical Template	System - Wastewater Effluent	System - Wastewater Effluent	n/a
Wastewater/Effluent: Secondary Analytical Template	None	None	n/a
Air Emissions: Sampling Frequency	Annually	Annually	n/a
Air Emissions: Primary Analytical Template	System Air Emissions - VOCs	System Air Emissions - VOCs	n/a
Air Emissions: Secondary Analytical Template	None	None	n/a
Solid Wastes: Sampling Frequency	Exclude from Estimate	Exclude from Estimate	n/a
Solid Wastes: Primary Analytical Template	None	None	n/a
Solid Wastes: Secondary Analytical Template	None	None	n/a
Heating Requirements			
Secondary Parameters			
Air Streams: Flow Rate	3,000	3,000	CFM
Air Streams: Temperature Difference	20	20	F
Air Streams: Months per Year	12	12	Month
Water Streams: Flow Rate	600	600	CFM
Water Streams: Temperature Difference	0	0	F
Water Streams: Months per Year	0	0	Month
Facility: Area	2,500	2,500	SF
Facility: Temperature Difference	0	0	F
Facility: Months per Year	0	0	Month

Comments: 1) Assume no maintenance is required on the carbon adsorbers.

Estimate Documentation Report

Technology Name: Groundwater Extraction Wells (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Number of Wells		20	EA
Flow Rate per Well		30	GPM
Type of Aquifer		Unconfined	n/a
Depth to Static Water Table		140	FT
Depth to Top of Confining Layer		0	FT

Technology Name: Air Sparging (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Quantity of Air Sparge Points		20	EA
Air Flow Rate per Well		5	CFM

Technology Name: Air Sparging (# 2) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Quantity of Air Sparge Points		20	EA
Air Flow Rate per Well		5	CFM

Technology Name: Soil Vapor Extraction (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Installation Type		Vertical Wells	n/a
Average Well Depth		140	LF
Vertical Well: Number of Vapor Extraction Wells		20	EA
Vertical Well: Total Vapor Flow Rate		3,000	CFM
Horizontal Trenches: Total Vapor Flow Rate		0	CFM

Estimate Documentation Report

Technology Name: Carbon Adsorption (Gas) (# 1) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Influent Flow Rate		3,000	CFM
Adsorption System		Dual Bed Carbon Adsorption Units	n/a
Influent Total Organic Concentration (for O&M)		0	ppm

Technology Name: Soil Vapor Extraction (# 2) - (O&M Parameters)

Description	Default	Value	UOM
O&M Parameters			
Installation Type		Vertical Wells	n/a
Average Well Depth		85	LF
Vertical Well: Number of Vapor Extraction Wells		13	EA
Vertical Well: Total Vapor Flow Rate		910	CFM
Horizontal Trenches: Total Vapor Flow Rate		0	CFM

Estimate Documentation Report

Phase Documentation:

Phase Type:	Long Term Monitoring
Phase Name:	Long Term Management
Description:	Five-year reviews for years 2016, 2021, 2026, 2031, 2036, 2041, including cost for site visits and reporting. Costs for long-term semiannual monitoring for VOCs at LF004 for 30 years. Includes 25 wells (average) for years 1 (2012) through 30 (2041).
Start Date:	January, 2012
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markups:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Five-Year Review	Yes	100	0
MONITORING	Yes	100	0
Residual Waste Management	Yes	100	0

Total Marked-up Cost: $979,733

Technologies:

Estimate Documentation Report

Technology Name: Five-Year Review (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Site Complexity		Moderate	n/a
Document Review		No	n/a
Interviews		No	n/a
Site Inspection		Yes	n/a
Report		Yes	n/a
Travel		No	n/a
Rebound Study		No	n/a
Start Date		January-2016	n/a
No. Reviews		6	EA
Site Inspection			
Required Parameters			
General Site Inspection		Yes	n/a
Containment System Inspection		No	n/a
Monitoring Systems Inspection		Yes	n/a
Treatment Systems Inspection		No	n/a
Regulatory Compliance		Yes	n/a
Site Visit Documentation (Photos, Diagrams, etc.)		Yes	n/a
Report			
Required Parameters			
Introduction		Yes	n/a
Remedial Objectives		Yes	n/a
ARARs Review		Yes	n/a
Summary of Site Visit		Yes	n/a
Areas of Non Compliance		Yes	n/a
Technology Recommendations		Yes	n/a
Statement of Protectiveness		Yes	n/a
Next Review		Yes	n/a
Implementation Requirements		Yes	n/a

Comments: Costs for 5-Year Reviews, in years 2016, 2021, 2026, 2031, 2036, 2041

Estimate Documentation Report

Technology Name: Monitoring (# 1)
User Name: MONITORING

Description	Default	Value	UOM
System Definition			
Required Parameters			
Model Name		MONITORING	n/a
Groundwater		Yes	n/a
Surface Soil		No	n/a
Surface Water		No	n/a
Subsurface Soil		No	n/a
Sediment		No	n/a
Soil Gas		No	n/a
Air		No	n/a
Site Distance (One-way)		30	MI
Safety Level		D	n/a
Groundwater			
Required Parameters			
Average Sample Depth		180	FT
Samples per Event (First Year)		25	n/a
Samples per Event (Out Years)		25	n/a
Number of Events (First Year)		2	n/a
Number of Events (Out Years)		2	n/a
Number of Years (Out Years)		9	n/a
Secondary Parameters			
Primary Analytical Template	System Water - VOCs	System Water - VOCs	n/a
Secondary Analytical Template	None	None	n/a
Turnaround Time	Standard (21 Days)	14 Day	n/a
Data Package/QC	Stage 1	Stage 1	n/a
Sampling Method	Existing Wells - Low Flow Pump	Existing Wells - Low Flow Pump	n/a
Number of Wells/Day	4	4	EA
Contain Purge Water	Yes	Yes	n/a
QA/QC			
Secondary Parameters			
Split Samples	1: 10	1: 10	EA
Field Duplicate Samples	1: 10	1: 10	EA

Estimate Documentation Report

Technology Name: Monitoring (# 1)
User Name: MONITORING

Description	Default	Value	UOM
QA/QC			
Secondary Parameters			
Rinse Blanks (per Round)	1	1	EA
Trip Blanks (per Day)	1	1	EA
Matrix Spikes/Matrix Spike Duplicates	1: 20	1: 20	EA
Data Management			
Secondary Parameters			
Monitoring Plan	Standard	None	n/a
Lab Data Review	Stage 1	Stage 1	n/a
Submit Data Electronically	Yes	Yes	n/a
Monitoring Reports	Abbreviated	Abbreviated	n/a

Comments:

Technology Name: Residual Waste Management (# 1)

Description	Default	Value	UOM
System Definition			
Required Parameters			
Safety Level		D	n/a
Non-Rad Disposal			
Required Parameters			
Waste Type / Condition		Non-Hazardous Drums	n/a
Total Quantity		1,709	Drums
Transportation Type		Truck	n/a
Truck Distance (One-way)		50	Miles

Comments: Assume 1 Drum/Well/Event = 1 drum x 25 wells x 2 events per year x 30 years ***QUANTITY IN ESTIMATE DOCUMENTATION REPORT DOES NOT REFLECT THE COCRRECT NUMBER OF DRUMS. THE ACTUAL COST ACCOUNTS FOR 1500, NOT 5125.

APPENDIX D

AIR FORCE RESPONSE TO EPA AND ADEQ COMMENTS

RESPONSE TO EPA COMMENTS DATED 13 SEPTEMBER 2013
DRAFT RECORD OF DECISION AMENDMENT, OPERABLE UNIT 1, LF004
FORMER WILLIAMS AFB, MESA, ARIZONA

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
General Comments					
1a.		1.3, 1.4, 5.2, Table 5-1	1049-1054	As currently written, the RODA repeatedly references the fact that institutional controls will be implemented to prevent human exposure to contaminants in soil gas and groundwater, and then goes on to describe those institutional controls as property use restrictions, prohibitions on groundwater extraction and well installation, protections of remedial systems, and assessment of risks presented by vapor intrusion to any new structures. See, e.g., Sections 1.3, 1.4, 5.2 (especially 5.2.1) and Table 5-1. While the RODA document intends to incorporate by reference the existing institutional controls in the original 1994 OU-1 ROD for LF004, and add restrictions related to soil gas and groundwater, for completeness and ease of reading, the substantive restrictions comprising the institutional controls relevant to this RODA should be imported into and directly stated in this document, and the specific restrictions being added should be defined here as well. As it is, Lines 1049-1054 are the closest thing there is to a description of actual substance of the institutional controls portion of the remedy, and that seems too general, where the RODA should be more prescriptive. If the four bulleted items in Section 5.2.1.1 are the primary land use restrictions required by this amended	Concur. The four bulleted items in Section 5.2.1.1 are the primary land use restrictions required by the original 1994 OU-1 ROD and the amended remedial decision. The last bullet listed includes the existing IC requirement from the 1994 OU-1 ROD to protect the integrity of the landfill cover and the operation of the groundwater monitoring system. The substance of the bulleted restrictions provided in Section 5.2.1.1 will be stated in Section 5.2.1 in order to define the institutional control component of the amended remedial decision. The four bullets will be introduced as the IC requirements in Section 5.2.1 after the first paragraph, as follows: "The existing and added ICs for the LF004 remedy are as follows : • Use of the LF004 capped area for residential purposes, hospitals for human care, public or private schools for persons under 18 years of age, or day-care centers for children is prohibited. • Installation of groundwater wells or extraction of groundwater from the property for any purpose other than remediation or monitoring is prohibited. • Structures intended for occupancy within areas impacted by COCs in shallow soil gas

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
				remedial decision, the substance of those bulleted restrictions should be part of the amended remedial decision, and not just part of a future deed or letter of transfer.	will be (a) designed and constructed in a manner that would mitigate unacceptable risk under CERCLA and the NCP (e.g., through installation of a vapor intrusion barrier or gas collection system); or (b) evaluated for the potential for unacceptable risk prior to the erection of any new occupied structure in the same area, and mitigated for vapor intrusion in the design/construction of the structure prior to occupancy if an unacceptable risk is posed under CERCLA and the NCP. • Activities that would cause disturbance of any equipment or systems associated with LF004 such as the permeable cap, interceptor trench and storm water drainage systems, LF004 fencing and signs, groundwater remediation and monitoring systems, and soil vapor remediation and monitoring systems are prohibited." i. The ICs, restrictions, and means of implementing the restrictions are detailed in the RODA. Based on the response to Comment 1a, Section 5.2.1 will describe and document the institutional controls that are applicable both before and after transfer. The Air Force will implement the ICs in accordance with Section 5.2.1 and its subsections. The Air Force Civil Engineer Center (AFCEC), as the signature authority for the RODA, retains the central organizational responsibility for ensuring that the prescribed institutional controls are
1b.				It is unclear how these institutional controls will be documented and implemented. i. Will the institutional controls not be documented until a transfer of the property, such that independent entities (or other branches of the Air Force) working on the water, gas, sewer, electrical, telephone or remedial or site security systems can know the land use restrictions? At a minimum, the substance of the specific, prescribed institutional controls (and specifically	

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
				land use controls) should be kept at some central location (i.e., the base master plan, or its functional equivalent) where any contractor, utility worker, or other worker could check to see the land use restrictions and controls prior to performing work. ii. If the Air Force intends to transfer this property to a sovereign tribal entity, has the Air Force discussed with the intended tribal transferee whether the transferee would be willing to record a Declaration of Environmental Use Restriction ("DEUR")—a creation of Arizona statute--on the property? In other OUs at Williams, the Air Force itself has recorded a DEUR on the property. Perhaps that should be considered here. iii. What happens if the property is not transferred to the tribe any time in the near future, or ever? As it is, the substance of the institutional controls is only contained in the language related to the deed or letter of transfer, and the Air Force states that it does not need to create any new, post-ROD IC implementation documents (like an LUC implementation plan, etc.).	implemented before and after transfer. AFCEC is responsible for real estate transactions and real property management for the Air Force, and these organizational functions within AFCEC are responsible for implementing the prescribed institutional controls in deeds, letters of transfer, leases, easements, and licenses. In accordance with the existing Operable Unit 1 remedy, access to LF004 is limited and controlled by fencing and locked gates. Authorized access to the property is only available via designated Air Force (AFCEC) personnel or authorized contractors. AFCEC ensures that for all contracts applicable to LF004, the prescribed institutional controls are designated compliance requirements. Compliance with the terms of the RODA will be protective of human health and the environment. Because the restrictions and the means for implementing the restrictions are specifically described in the RODA, it is not necessary for the AF to submit any new, post-ROD IC implementation documents, such as a land use control implementation plan, new OM&M plans, or remedial action work plan for the restrictions. ii. Preliminary discussions between the AF and tribal entity have been initiated. . If Parcel N, on which LF004 is located, is transferred to the Department of Interior and held in trust by the Bureau of Indian Affairs for the Gila River Indian

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
					Community, the letter of transfer to DOI will include the institutional controls and land restrictions prescribed by the RODA. A relevant excerpt and revisions included in Section 5.2.1.2 of the Draft Final RODA are provided below. "The AF will include similar restriction language set forth in this ROD Amendment in the deed or letter of transfer for any portion of property within the LF004 IC compliance boundaries, and will provide a copy of the deed(s) or letter(s) of transfer containing the use restrictions to the regulatory agencies as soon as practicable after the transfer of fee title. The AF will inform the property owner(s) of the necessary ICs in the draft deed(s) or transfer documents. The signed deed(s) and/or transfer document(s) legally binding between the AF and transferee will also include the specific land use restrictions. Deeds for non-federal entities will include a condition that the transferee execute and record a DEUR, within 10 days of transfer, to address any State obligations pursuant to State law, including ARS §49.152. The AF will ensure that the transferee has met this condition. Any letter of transfer (to a federal entity) will include a condition that future deeds (non-federal entity) include this requirement. For any transfer, including to the Department of Interior and Bureau of Indian Affairs as trustee for the Gila River Indian Community, federal enforcement authority under CERCLA applies and the AF retains responsibility for the remedy, over

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
					which both the EPA and ADEQ have designated regulatory authorities. " Please see the response to Comment 1a which indicates that the substantive language included in Section 5.2.1.1 will be included in Section 5.2.1 in order to describe the ICs that apply both before and after transfer. Please see the response to Comment 1b(i) in regard to IC implementation.
1c.				It does not appear that any PCE or TCE exceedences have been confirmed off-site, though the plume maps in Figures 3-5 and 3-6 predict that contaminated groundwater above MCLs probably already does underlie off-site properties. Despite these figures, the proposed compliance boundaries for institutional controls appear to be fence lines. What is the Air Force's plan for implementing groundwater institutional controls on off-site properties now, or if exceedences are detected later?	Detections of TCE have not exceeded the MCL (5 µg/L) in groundwater in off-site wells. PCE has been detected above the MCL (5 µg/L) at one off-base location (LF01-W35M) at a concentration of 8.7µg/L in May 2012 and 6.2 µg/L in November 2012 (see Figure 3-5). Results for May 2013 are 5.2 µg/L (Draft Groundwater Monitoring Report, May 2013, Site LF004, AMEC, October 2013). Based on the declining PCE concentration that is currently equivalent to the MCL, the small area of off-site plume area, and the absence of groundwater use, no institutional controls are proposed for off-site groundwater. The PCE plume area including the property boundary will be the subject of early remedial action efforts such that continued decline to levels at or below the MCL is anticipated. These early remedial efforts have been initiated with the LF004 Pre-Design Investigation that includes operating a remediation well in the center of the PCE plume area. Groundwater monitoring established as part of the existing and amended remedy would assess any future groundwater detections.

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
2				The RODA describes the IWAS well technology in very general terms; it would be helpful to include a process diagram to illustrate how the technology works.	The process schematic diagram of the technology that was presented in the proposed plan has been included on a new Figure 5-2.
3				While it is understood that the Remedial Design will determine the precise layout of wells, the ROD could be more specific in depicting the proposed treatment locations at a minimum to the extent that was provided in the Feasibility Study.	Conceptual design figures indicating layouts of the IWAS/oxidation wells were presented in the FFS; however, they were based on earlier groundwater sampling events. The final design will be presented in the Remedial Design/Remedial Action Work Plan and will differ in specific well locations and numbers from the FFS conceptual design figures based on pre-design groundwater sampling results. Also, the extent of treatment areas requiring sequential phases of implementation are anticipated to be based on observed concentrations during initial phases of treatment. A new Figure 5-2 has been added that shows the conceptual layout of IWAS wells from the FFS. The previous Figure 5-2 has been renumbered.
Specific Comments					
1	3-6	3.2.2	416	The sentence states that a “potential” source area was not identified, where “specific” appears to be the intended meaning. Potential source areas were identified and investigated during the field work.	The word “potential” has been replaced with “specific”.
2	3-7	3.2.2	462	Delete extra hyphen after the sentence.	The hyphen has been deleted.

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
3	5-3	Table 5-1	880	Second Row, Third Column: Should the text read "Install supplementary oxidant injection wells or apply oxidant directly to IWAS wells to reduce overall *time/duration of* treatment" [language in italics added]? Otherwise, the existing text could be read to mean that treatment itself is being reduced.	The suggested text has been added.
4	5-4	5.1	917-918	This sentence is confusing, perhaps because of the passive tense. Consider rewording to something like "Air Force will continue to analyze groundwater for these COPCs, as well as other groundwater COPCs identified in the OU-1 ROD, during implementation of the amended Selected Remedy."	The sentence has been revised to read, "The AF will continue to monitor for these COPCs, as well as other groundwater COPCs identified in the OU-1 ROD, during implementation of the amended Selected Remedy."
5	5-6	5.1	939	The reference to Arizona Heath Based Guidance Levels (HBGLs) "no longer in effect [sic] needs justification.	With the deletion of OU-1 ROD remediation goals from Table 5-3 (see next comment), the subject note has been deleted.
6	5-5	Table 5-2	925	While the current TCE MCL is 5 µg/l, the current risk based RSLs are much lower. EPA Region 9's published risk based standards are 0.44 µg/l for 10^{-6} cancer risk and 2.6 µg/l for non cancer Hazard Index of 1. On that basis EPA does not support increasing the cleanup level for TCE from the original ROD.	The OU-1 ROD did not select a groundwater remedy for LF004 and therefore did not establish groundwater cleanup levels. The TCE MCL is the current relevant and appropriate requirement upon which to base the cleanup level. To avoid confusion, the OU-1 ROD Remediation Goal columns has been deleted from Tables 5-2 and 5-3. The OU-1 ROD Remediation Goals for groundwater reflect preliminary remediation goals that were used prior to the OU-1 ROD for screening remedial investigation groundwater results and evaluating potential groundwater risks. Since

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
					no groundwater remedy was selected in the OU-1 ROD, the OU-1 ROD Remediation Goals did not become cleanup levels. Therefore, the cleanup level for TCE is being established in the RODA, not increased from the OU-1 ROD.
7	5-6	5.1	950-958	Is the Air Force committing to performing a site-specific risk assessment to demonstrate progress toward the risk-based remedial action objectives for soil gas? If so, why is the selected site-specific screening level considering a target cancer risk of 1 x 10-5, instead of 1 x 10-6, especially since AF is willing to justify and final [sic] ILCR above 1 x 10-6?	As noted in line 947 of the Draft RODA, a site specific risk for soil gas will be conducted. The target cancer risk of 1×10^{-5} is used as the basis for unrestricted residential use under Arizona Revised Statute R18-7. Consideration of the 1×10^{-6} to 1×10^{-4} risk management range and substantiation of the basis for establishing a site-specific remediation level that is greater than 1×10^{-6} is consistent with ARS R18-7-206, the NCP [(40CFR300.430(e)(2)(i)(A)(2)] and OSWER 9355.0-30.
8	135	Table A-1, AAC, Title 18, Chapter 2		The substantive standards of the general permit application should apply, but CERCLA should exempt Air Force from the procedural process of having to get the permit itself.	Agreed, the permit exemption process is described in the text (see page A-2 line 85 of the Draft ROD Amendment).
9		References		Please include Administrative Record number for cited references to facilitate document retrieval.	The Administrative Record number has been included for cited references.

RESPONSE TO ADEQ COMMENTS DATED 17 OCTOBER 2013
DRAFT RECORD OF DECISION AMENDMENT, OPERABLE UNIT 1, LF004
FORMER WILLIAMS AFB, MESA, ARIZONA

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
General Comments					
1				The document should assure that subsequent land owners, including Federal government agencies such as Bureau of Indian Affairs (BIA), will maintain existing institutional controls, as appropriate. With respect to any potential jurisdictional land transfer to the BIA, ADEQ is concerned that the existing State of Arizona Declaration of Environmental Use Restrictions (DEURs) would not be transferred to new owners. The Record of Decision (ROD) should include provisions to guarantee that the BIA federal Indian trust maintains State of Arizona institutional controls. Maintaining institutional controls (via DEUR or equivalent) should be a condition of acceptance by all subsequent landowners and enforceable by the state.	The Record of Decision Amendment (RODA) 1, Operable Unit 1 (OU-1) includes provisions to achieve the cleanup levels and other ARAR or remedial action objective requirements of the RODA including the ICs. Maintaining the institutional controls (via DEUR or equivalent) is a condition of transfer. Section 5.2.1 addresses maintenance of institutional controls and property transfers. Relevant excerpts and revisions included in the Draft Final RODA are provided below. In regard to maintaining institutional controls as appropriate – RODA Section 5.2.1: …"the AF is ultimately responsible for the remedy (including institutional controls) before and after property transfer." …"the AF is ultimately responsible under CERCLA for the successful implementation of ICs, including monitoring, maintenance, and review of ICs. Monitoring, maintenance, and other controls as established in accordance with this ROD and the appropriate transfer documents will be continued until ICs are no longer necessary."

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					"Institutional controls shall be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels as to allow for unlimited use and unrestricted exposure." In regard to transfer of institutional controls to new owners – RODA Section 5.2.1.1: "The federal deed(s) or letter(s) of transfer for any property within the IC boundaries will include a description of the residual contamination on the property, consistent with the AF's obligations under CERCLA Section 120(h), and the specific restrictions set forth in this section. The deed(s) or letter(s) of transfer will include a legal description of the property to which the ICs apply and will contain provisions so that they run with the land (i.e., the restrictions will be binding on all subsequent purchasers of the land whether or not the deed to them contained the restrictions)." "For any deed (non-federal entity) or letter of transfer (federal entity) transferring all or part of property within the LF004 IC compliance boundaries, ICs, in the form of land use restrictions, will be incorporated in the deed or letter of transfer as a grantee covenant,".

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					RODA Section 5.2.1.2: "The AF will include similar restriction language set forth in this ROD Amendment in the deed or letter of transfer for any portion of property within the LF004 IC compliance boundaries, and will provide a copy of the deed(s) or letter(s) of transfer containing the use restrictions to the regulatory agencies as soon as practicable after the transfer of fee title. The AF will inform the property owner(s) of the necessary ICs in the draft deed(s) or transfer documents. The signed deed(s) and/or transfer document(s) legally binding between the AF and transferee will also include the specific land use restrictions. Deeds for non-federal entities will include a condition that the transferee execute and record a DEUR, within 10 days of transfer, to address any State obligations pursuant to State law, including ARS §49.152. The AF will ensure that the transferee has met this condition. Any letter of transfer (to a federal entity) will include a condition that future deeds (non-federal entity) include this requirement." Note – The following sentence will be added to the end of the above excerpt from Section 5.2.1.2: "For any transfer, including to the Department of Interior and Bureau of Indian Affairs as trustee for the Gila River Indian Community,

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					federal enforcement authority under CERCLA applies and the AF retains responsibility for the remedy, over which both the EPA and ADEQ have designated regulatory authorities. “ In regard to maintaining institutional controls - RODA Section 5.2.1.3: “The Air Force will place the following two transferee obligations in the deed or other transfer documentation: (1) Upon the effective date of property conveyance, the transferee (or other entity accepting such obligations [which may include, without limitation, subsequent transferees] or subsequent property owner(s)) will conduct annual physical inspections of the property to confirm continued compliance with all institutional control objectives unless and until the institutional controls at the site are terminated; (2) The transferee or subsequent property owner(s) will provide to the Air Force, the EPA, and ADEQ, an annual monitoring report on the status of the institutional controls and how any institutional control deficiency or inconsistent uses have been addressed, whether use restrictions and controls were communicated in the deed(s) for any property transferred in the reporting period, and whether use of the property encompassing the area subject to institutional controls has conformed to such restrictions

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					and controls."
2				The document should include a contaminant record table presenting a complete history of each contaminant's high-to-low concentration range, average concentration, contaminant-detected quantity compared to total samples analyzed quantity, regulatory agency remediation levels and/or contaminant impact-to-health concentrations, and other information which would present proof of a complete potential contaminant of concern search.	The list of groundwater COPCs for LF004 was established in the OU-1 ROD. Table 4-3 from the OU-1 ROD provides a summary of the groundwater monitoring results as documented in the OU-1 ROD and has been included in a new Appendix A. Table A-1 (shallow soil gas), Table A-2 (deep soil gas), and Table A-3 (groundwater) have been added that include the low-to-high concentration range, average concentration, contaminant-detected quantity compared to total samples analyzed quantity (referred to as frequency of detection), and the well location of the maximum detected concentration for each contaminant of potential concern reported for the supplemental RI (soil gas) and the November 2012 semiannual groundwater monitoring event (groundwater). Presentation of the information requested in the comment for groundwater is provided for November 2012 since it is the most current published data for LF004. November 2012 groundwater monitoring data are appropriate and sufficient to support remedy selection since they are consistent with the basis for evaluation of remedial alternatives in the OU-2 Focused Feasibility Study and are the basis for groundwater contaminant distribution maps provided in the OU-1 ROD Amendment (Figures 3-5 and 3-6). As additional supporting information, the maximum historical detected concentration and location

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					in groundwater is provided for each of the COPCs. Regulatory limits for groundwater COCs/COPCs are summarized in Tables B-2 and B-3 in Appendix B (formerly Appendix A). Text at the end of Section 3.2.3 was revised as follows: "Tables A-1 and A-2 in Appendix A summarize shallow and deep soil gas contaminants from the supplemental RI. The shallow (0-15 feet bgs) soil gas samples were analyzed in a field laboratory by SW8021B (modified) for PCE, TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and trans-1,2-dichlroroethene (trans-1,2-DCE). . Deep soil gas samples were analyzed for VOCs at a laboratory by Method TO-14A or TO-15. Tables A-1 and A-2 support that PCE and TCE are the primary VOC contaminants in soil gas at LF004." The following was inserted at the beginning of paragraph 4 of Section 3.2.3. "In accordance with the OU-1 ROD, groundwater monitoring has been conducted and presented in groundwater monitoring reports, the most recent of which is for the sampling completed in November 2012. Consistent with the contaminants of potential concern (COPCs) identified in the OU-1 ROD, LF004 groundwater sample analyses are conducted for VOCs and inorganics in

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					order to monitor groundwater conditions including contaminant concentrations, concentration trends, contaminant distribution, and potential contaminant migration. Recommendations are provided in the groundwater monitoring reports for additions or modifications to the monitoring program as needed." Text at the end of Section 3.2.3 was revised as follows: "Table 4-3 from the OU-1 ROD, provided in Appendix A, summarizes detected groundwater contaminants from the historic groundwater monitoring data available prior to the OU-1 ROD. Table A-3 provides summary information for COCs/COPCs identified from the November 2012 semiannual groundwater monitoring event (AMEC, 2013d) and from historical groundwater monitoring completed from 2000 through 2012. November 2012 groundwater monitoring data are the most current published data for LF004. November 2012 groundwater monitoring data are appropriate and sufficient to support remedy selection since they are consistent with the basis for evaluation of remedial alternatives in the OU-1 FFS and the groundwater contaminant distribution maps provided in the OU-1 ROD Amendment (Figures 3-5 and 3-6). Table A-3 supports that PCE and TCE are the primary VOC contaminants in groundwater at LF004."

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
3				In numerous instances, the text refers to "MCLs/AWQSs", "AWQSs/MCLs", or simply "AWQSs". If the selected remedial goal is the MCL, then please delete references to the AWQS.	References to AWQSs have been deleted in the text except where needed. The following was added at the end of the first paragraph in Section 3.2.3: "The EPA MCLs and the Arizona AWQSs for PCE and TCE are both 5 micrograms per liter [µg/L] so the remainder of this section refers to MCLs."
4				The discussion of cleanup goals is inconsistent with the Final Focused Feasibility Study. Table C-2 of the FFS cites the Arizona Aquifer Water Quality Standard as the Applicable requirement for groundwater COCs and COPCs, whereas the ROD Amendment (Tables 5-2, 5.3, A-2, and A-3) cites the EPA MCL for those constituents. The document should include a brief discussion explaining the reason or reasons for changing the references cited in the FFS to those cited in the ROD Amendment 2.	Appendix C of the FFS and Appendix B of the RODA cite 40 CFR Section 300.5 in establishing that only state standards that are more stringent than federal requirements are ARARs. As can be seen from Table C-2 of the FFS, the Arizona AWQSs are equal to the federal MCLs for all listed contaminants. On this basis, and in accordance with 40 CFR 300.5, federal MCLs are the ARAR when a more stringent state standard isn't established. ROD Amendment Tables 5-2, 5-3, B-2 and B-3 have been updated to reflect federal MCLs as the ARARs basis if a federal MCL is established and there isn't a more stringent state standard. The following has been added to Section 5.1. "The LF004 FFS identified Arizona AWQSs as the basis for some preliminary remediation goals including TCE and PCE. The Arizona AWQSs for TCE and PCE are equal to the federal MCLs. Code of Federal Regulations (CFR) Part 40 Section 300.5 establishes that only state standards that are more stringent

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					than federal requirements are ARARs. ROD Amendment Tables 5-2, 5-3, B-2 and B-3 identify federal MCLs as the ARARs basis if a federal MCL is established and there isn't a more stringent state standard."
5				The FFS COPCs for indoor air (FFS Tables 4-1, 4-2, 5-1, and C-3) included PCE, TCE, 1,1-DCE, cis-DCE, trans-DCE, and VC. The ROD amendment only discusses PCE and TCE as Chemicals of Concern for shallow soil gas without an explanation as to why the additional COPCs were removed. Please include a discussion indicating why the additional COPCs were not carried through to the ROD Amendment.	The following text has been added to the paragraph following Table 5-4: "Although PCE and TCE intermediate degradation products of 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were discussed in the FFS as COPCs for soil gas, they have not been detected at concentrations that pose a potential unacceptable risk to human health. Cis-1,2-DCE and trans-1,2-DCE were analyzed for in shallow soil gas during the Supplemental RI but not detected (URS, 2010b) (see Table A-1). 1,1-DCE and vinyl chloride were not analyzed for in the shallow soil gas screening samples but all of the degradation products were analyzed for in laboratory samples collected as part of the deep soil gas investigation. There were only sporadic detections of the degradation products trans-1,2-DCE (2 of 125 samples) and 1,1-DCE (4 of 21 samples) in deep soil gas results (see Table A-2). The AF will monitor for all of the degradation compounds and, if detected, include them in the site-specific risk assessment for soil gas and the vapor intrusion exposure pathway."

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
6				Regulatory Agency (ADEQ, EPA, etc.) concurrence/interaction with investigative conclusions, project milestone achievements, actionable findings, etc. should be presented to document the path toward this Record of Decision (ROD) and any subsequent Amendments to the ROD. Because this is a public document that defines a final remedy for the site, it is important that the public is assured of the regulatory agencies' concurrence with the methods used and the technologies implemented to arrive at the final decision. The public should be able to track the investigative basis and corresponding regulatory concurrence/interaction used to arrive at the ROD and, as appropriate, Amendment decisions. Documentation may include referencing/including Regulatory Agency concurrence letters, Responsible Party Responses to Agency Comments, etc.	The public can be assured of the regulatory agencies' concurrence with the methods used and the technologies implemented in regard to the LF004 remedy decision based on the following: 1) The AF's and agencies' fulfillment of their respective roles and responsibilities as established in the Federal Facility Agreement referenced in Section 2.0 of the OU-1 Record of Decision (ROD) Amendment. 2) AF compliance and regulatory agency involvement in fulfilling the Public Participation requirements of CERCLA discussed in Section 9 of the OU-2 ROD Amendment 2. 3) Resolution of agency review comments on the ROD Amendment 2 as addressed in Section 7 and Appendix D. 4) Regulatory agency signature of the OU-2 ROD Amendment 2 indicating that, as stated in the Declaration, the EPA approves of and the ADEQ concurs with the remedy selected by the OU-2 ROD Amendment 2. In addition to the above, Table 3-1 has been updated to include an additional column that documents the status of regulatory concurrence/interaction for each of the documents listed. Secondary documents identified in Table 3-1 are subject to review and comment by the EPA, ADEQ, and

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
					ADWR and may include AF responses; however, final resolution and concurrence is reserved until the corresponding primary document is completed. The following note has been added to the end of the table: "As defined in the FFA, secondary documents are discrete portions of, or input/feeder documents to, primary documents. Secondary documents are subject to review and comment by the EPA, ADEQ, and ADWR and may include AF responses; however, final resolution and concurrence is reserved until the corresponding primary document is completed."
Specific Comments					
1	1-2	1.3	182	Clarify discussed Alternatives. Alternative 5 is IWAS (in-well air stripping), oxidation, and SVE. Alternative 2 is in-situ air, ozone and SVE. Section 1.4, Line 188, discusses Alternative 5 as IWAS, oxidation, and SVE. Line 189 discusses using air sparging, with or without ozone, as Alternative 2 and will be retained for potential implementation to augment the amended Selected Remedy. Assumption is that if Alternative 2 is used with the use of ozone, then this alternative is no different than Alternative 5. But if ozone is not used, then Alternative 2 is the selected remedy. This is confusing. Would be clearer if Alternative 2 was the	The intent is to retain air sparging as a technology element from Alternative 2 as was suggested in the response to EPA specific comment 9 on the draft FFS and as described in the Amended Proposed Plan. To reduce confusion, the phrase "with or without ozone" has been removed from the sentence since ozone sparging is already covered under the oxidation component of Alternative 5. Please note that air sparging (injection of air to facilitate stripping of volatile contaminants and transfer to the vadose zone for removal by soil vapor extraction) is different from IWAS whether or not ozone or other oxidants are used. IWAS wells include a submersible pump and are designed to

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
				selected remedy and air sparging[sic].	cause a recirculation effect that can provide more efficient treatment than air sparging alone.
2	2-1	2.0	278	The Former Williams Air Force Base is not located adjacent to any portion of Pinal County. The reference to Pinal county should be removed.	The change has been made.
3	2-1	2.0	285	Add an appropriate citation and include the FFA in the references section of the ROD Amendment.	The changes have been made.
4	3-1 thru 3-4	Table 3-1		EPA and ADEQ concurrence letters and/or Responsible Party responses to agency comments should be included/referenced to demonstrate regulatory agencies' interaction/concurrence.	See response to general comment 6.
5	3-7	3.2.2	457	Add an opening parenthesis to the phrase "128-155 ft bgs)".	The change has been made and the comma has been removed.
6	3-11	3.3	624	Line 624 not used	The line has been removed.
7	5-8	5.2	1034-1037	Please revise the sentence to read "In the absence of alternative mutual agreement between the AF, EPA and ADEQ, cleanup levels will have been attained when monitoring results throughout the plume reach concentrations at or below the cleanup levels and remain below cleanup levels	The change has been made.

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
				throughout a two year period of continued groundwater monitoring after cleanup levels were initially achieved."	
8	5-14	5.2.1.6	1263	Replace "State" with "Arizona".	The change has been made.
9	5-14	6.8	1390	Add the word "Plan" at the end of the sentence.	The change has been made.
10	A-8	Appendix A	Tables A-2 and A-3	The EPA MCL should be listed in the "Applicable" column rather that the "Relevant and Appropriate" column.	The National Primary Drinking Water standards established under the SDWA were identified in Table A-1 (now B-1) as relevant and appropriate because the SDWA applies to public drinking water systems but, as promulgated, is not directly applicable to groundwater aquifers. Tables A-2 and A-3 (now B-2 and B-3) were not changed.

RESPONSE TO EPA COMMENTS DATED 9 JANUARY 2014
DRAFT FINAL RECORD OF DECISION AMENDMENT, OPERABLE UNIT 1, LF004
FORMER WILLIAMS AFB, MESA, ARIZONA

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
General Comments					
1b				Institutional Controls: Given that AF intends eventually to transfer the property to third party(s) who may be charged with carrying out institutional controls (ICs), (line 1115, page 5-10) a central searchable database should be created to inform future property owners and operators of all land use restrictions on the former Williams AFB. The AF's response that new post ROD implementation documents for ICs will not be necessary seems premature, as transferees will be expected to consider and implement ICs in all of their future activities on the property and will need to incorporate ICs in their planning documents. Additionally, AF could record a DEUR on this parcel, as it has done on other parcels at Williams, to notify the public (including anyone working on the parcel prior to transfer) of the land use restrictions prescribed by the RODA.	Creation of a central searchable database is not a requirement for IC implementation. RODA Section 5.2.1 indicates that there is no need for the RODA to specify the creation of a new post-ROD IC implementation document since the means for implementing the restrictions are specifically described in the RODA. The Air Force will implement the ICs in accordance with Section 5.2.1 and its subsections, including compliance with restrictions listed in Section 5.2.1, deed restrictions (Section 5.2.1.1), notification of the restrictions (Section 5.2.1.2), annual evaluations and monitoring (Section 5.2.1.3), and responses to violations (Section 5.2.1.4). There is no need for the Air Force to record a DEUR for LF004 at this time; the Air Force retains ownership pending a demonstration that the groundwater remedy is operating properly and successfully. No work can be performed at LF004 without prior notification of, and coordination with, the Air Force. The Air Force is responsible for the remedy pursuant to the requirements of CERCLA and the record of decision, and will ensure compliance with institutional controls as described in Section 5.2.1.
1c				Extent of Contamination: PCE exceeding the MCL has been previously found in offsite well LF01-W35M. While AF believes that the proposed remediation will address the offsite contamination, this has yet to be demonstrated through long term monitoring. The extent of contamination has been	All November 2013 sample results for LF01-W35 are below the MCL. An initial remediation well (RW-2) has been installed and is operating on the property boundary near the LF01-W35 location. The extent of contamination has been defined to the level of detection since trichloroethylene and perchloroethylene have not been detected at

Item	Page	Section	Line(s)	EPA Comment	Air Force (AF) Response to Comment (RTC)
				defined to date only to the level of the current drinking water Maximum Contaminant Level (MCL) standard which may change in the future. If the MCL changes or the remedy fails to meet the remedial action objectives further characterization and possible expansion of ICs beyond the former WAFB property boundaries may be warranted in the future.	LF1-W36. The selected remedy as described in the RODA remains appropriate for current conditions. If cleanup standards change or if groundwater TCE or PCE levels increase above the MCL in offsite wells and the remedy fails to achieve cleanup levels offsite, further characterization and, potentially, expansion of institutional controls, may be warranted in the future.
Specific Comments					
6				Current TCE Regional Screening Level RSL lower than MCL: While the MCL is a promulgated standard and appropriate to use as Applicable and Relevant and Appropriate Requirement to set the remediation goal for TCE, AF should be advised that the standard is currently in review and may be adjusted downward in the future. The appropriateness of use of the 5 µg/ml [sic] cleanup goal specified in the ROD will be reevaluated at the time of the 5 year review, and further action may be warranted at that time.	Changes in standards identified as Applicable or Relevant and Appropriate Requirements (ARARs), newly promulgated standards, and changes in to be considered criteria identified in the RODA will be evaluated at the time of the 5 year review. If such changes, including a change in the TCE MCL, call into question the protectiveness of the remedy, then changes to the cleanup goal(s), selected remedy, and/or extent or duration of the remedial action could be warranted at that time.
10	4-2		703-704	The text references "the same set of exposure assumptions as above", however the preceding paragraph does not specify what the referenced exposure assumptions are, and does not provide the reader with a reference to where they can find the complete risk analysis.	Text has been changed to read: “Utilizing the same set of exposure assumptions as used for the RSLs (EPA, 2013d)…” References to RSLs have been updated throughout the final document.

Note: Item numbers 1b, 1c, and 6 are continued discussion on comments submitted on the Draft Final ROD Amendment.

RESPONSE TO ADEQ COMMENTS DATED 11 DECEMBER 2013
DRAFT FINAL RECORD OF DECISION AMENDMENT, OPERABLE UNIT 1, LF004
FORMER WILLIAMS AFB, MESA, ARIZONA

Item	Page	Section	Line(s)	ADEQ Comment	Air Force (AF) Response to Comment (RTC)
Specific Comments					
1		App. A	Table A-1	The Screening Level column does not contain values.	The screening levels have been added. Note the screening levels previously listed in Table A-2 were updated for correct application of the attenuation factor.

DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEER CENTER

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706 Hangar Road
Rome, NY 13441

4 June 2014

Ms. Carolyn d'Almeida
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75 Hawthorne Street
San Francisco, CA 94105

and

Mr. Wayne Miller, P.E., R.G.
Arizona Department of Environmental Quality
1110 West Washington Street, 4415B-1
Phoenix, Arizona 85007

Subject: Submission of "Final Record of Decision Amendment, Operable Unit 1 (OU-1), Site LF004, Former Williams Air Force Base, Mesa, Arizona"

The Air Force is pleased to submit the attached document, *Record of Decision Amendment* (RODA), in final format for your records. Section 1.7, Authorizing Signatures, now includes signatures by the Air Force Civil Engineer Center, the U.S. Environmental Protection Agency, Region IX, and Arizona Department of Environmental Quality. This signed copy of the Final RODA will be uploaded to the Administrative Record online at http://afrpaar.lackland.af.mil/ar as document number 301070. A copy is being provided by this distribution to the Arizona State University Library.

This transmittal replaces the signed Final RODA distributed on 30 May 2014. The Administrative Record number has been corrected and the report date has been changed to May 2014 to correspond with the final approval signature. Please discard or recycle any electronic and hard copies of the 30 May 2014 submittal.

This RODA represents another milestone in the successful clean-up of the former Williams AFB and is a result of our partnership with the State of Arizona and U. S. Environmental Protection Agency.

Sincerely,

CATHERINE JERRARD, PE
BRAC Environmental Coordinator

Attachment:

Final Record of Decision Amendment, Operable Unit 1 (OU-1), Site LF004, Former Williams Air Force Base, Mesa, Arizona

c: Addressee (1 and 1 CD)
ADEQ - Wayne Miller (2 and 1 CD)
Administrative Record – Terie Glaspey (1 and 1 CD)
AFCEC –Catherine Jerrard (1 and 1 CD)
ASU Libraries – Dan Stanton (1 and 1 CD)
CNTS – Geoff Watkin (1 and 1 CD)
TechLaw – Bill Mabey (electronic via Sharepoint)
TechLaw – Michael Anderson (1 CD)
USEPA – Loren Henning (1 and 1 CD)
USEPA – Thomas Butler (1 and 1 CD)
UXOPro – Steven Willis (1 CD)
File